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Fig. 13.

Fig. 14.

Fig. 15.

Fig. 13. Case 4. Full lateral view, showing flattening of nose, due to absence of cartilages with the elevation of tip. Implanted cartilage seen in the hair line.

Fig. 14. Case 4. Plaster cast of face and nose before operation with outlining of flap before operation. *a b c d*, The portion to form new nose; *f a d p*, the tubed, temporal pedicle; *d c*, the hinge upon which the flap was lifted up with the pericranium attached, under which Thiersch grafts were placed. In the center of *a b c d*, is seen the implanted cartilage. Below on nose is seen the area denuded.

Fig. 15. Case 4. Showing the implanted cartilage with tubing of the pedicle to right. To the left, lower part of nasal portion of flap lifted up, being hinged above, Thiersch skin grafts being placed under the pericranium and the flap replaced. Cellosilk is between the skin grafts and bone, projecting below.

Fig. 16.

Fig. 17.

Fig. 18.

Fig. 16. Case 4. Result 2 weeks after the flap was transplanted from forehead into nose with a right, tubed, temporal pedicle. The forehead defect was left to granulate. Notice that almost the entire lower forehead is free from future scarring. The furrow to right of nose in flap is caused by jaws of a periodically compressing forceps.

Fig. 17. Case 4. Taken 4 weeks after final operation. Full face. Hair covers entire forehead scar. Excellent cosmetic result.

Fig. 18. Case 4. Shows portion, after replacing flap which required Thiersch skin grafting. Scar of this high forehead flap will be entirely hidden by the hair.

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RHINOPLASTY AND CHEEK, CHIN, AND LIP PLASTICS WITH TUBED, TEMPORAL-PEDICLED, FOREHEAD FLAPS[1]

BY CLARENCE A. McWILLIAMS, M.D., F.A.C.S., AND HENRY S. DUNNING, M.D., NEW YORK CITY

DEFORMITIES of the nose are common, and, for their correction, a special technique has been devised which will depend exactly on the extent and character of the tissues to be supplied. Thus, we may divide them into:

1. Minor deformities of the nose which require no additional supporting structures to be supplied, as, (a) large hooked, humped, angular or beaked; (b) long; (c) laterally defected, bent or twisted; (d) snub; (e) bulbous, tuberous and rhinophyma; (f) wide-nostriled. Procedures to correct these deformities will not be considered in this paper.

2. Major deformities which require additional structures to be supplied, such as cartilage and skin, thus, (a) depressed, or saddle nose; (b) partial loss of skin or cartilage, or complete loss of whole nose. These major deformities alone will be considered in this paper.

SADDLE NOSE

Saddle nose is a frequent and very disfiguring nasal deformity, for which the transplantation of some supporting structure is necessary. There is nothing to equal transplanted cartilage for cosmetic purposes. Tieck, with some others, asserts that transplanted cartilage becomes absorbed, others maintain the contrary. Gillies has had persistence for 3 years, and he says that the cartilage remains permanently of the same shape and size as it was when imbedded, with the exception that, if one perichondrial surface only is left, the graft tends to bend, the perichondrium occupying the concavity; and this property of cartilage is utilized by the surgeon to obtain a curve in such positions as the eyelids or the mandible. The clinical evidence of the permanence of cartilage is borne out by the experimental work of John Staige Davis[2] and by the histological work of Keith and Murray. Cartilage can easily be obtained from the seventh and eighth ribs, being readily cut with a knife and shaped accordingly. Any excess of cartilage is inserted under the skin of the upper abdomen or chest as a store for use in future operations, the pain of a further rib excision being thus avoided. If, before implantation, an incision is made transversely across the cartilage (Fig. 2, *a*) but not entirely through it, three-quarters of an inch above its lower extremity, the inferior portion, at the incision, can be bent so as to lie anteroposteriorly to form a cartilaginous support for the columella (Fig. 3). Our experience with transplanted cartilage in three cases, that we have followed, is this: One patient (Case 3, Figs. 10 and 11) has now gone 7 years, and two others, 2 years (Cases 1 and 2, Figs. 5 to 9, inclusive), since the operations. In the 7-year case, the cartilage has persisted as evidenced by X-ray and palpation so that the nose is as shapely as ever. In the two boys, 2 years after opera-

[1] Read before the American Surgical Association, May 1, 1922.

[2] Ann. Surg., 1917, xlvi, 58.

tions, the cartilages are felt by palpation to have likewise persisted though they do not appear in the X-ray pictures, so that the reputed objection to implanting cartilage, because it will disappear, is not valid. Ivy, Berne, and Ferris Smith likewise maintain that cartilage will not be absorbed. It would seem to us that the reason why some maintain that the cartilage has disappeared is because they have not obtained a shadow of the cartilage in the subsequent X-rays. We have examined the X-rays of normal noses taken for other purposes, and have found that cartilage usually does not appear in the X-rays, particularly if the subjects be young. In normal adults, the cartilage *may* show if it has become calcified. In most cases it does not show. A picture of one of the authors' noses taken for the purpose of seeing whether the cartilage would show, elicits the fact that it does not appear in the X-ray.

Figure 1 shows the incisions practiced for inserting cartilage into a saddle nose. The authors have used incision *a* for the simple insertion of a strip of cartilage for saddle nose where support for the columella is not to be supplied. This incision, in a year's time, is scarcely visible. It comes under the cross bar of a pair of spectacles. Incision *a* is preferred because of the danger of infection with incision *d*.

Figures 2 and 3 give the technique of inserting cartilage when support for the columella must also be supplied. Infection is not serious in cases of cartilage implants, as is shown in Cases 1 and 2, in both of which infection occurred without subsequent injury to the cartilages. Figure 4 shows the various methods of inserting the cartilages, depending upon the amount of support necessary.

ILLUSTRATIVE CASES

Case 1. Figs. 5, 6 and 7. (C. A. McW.) Lad, age 15, affected with saddle nose, the result of congenital syphilis. All the cartilages of the nose were gone, producing a marked depression in center of nose with broadening, causing an unsightly deformity. Wassermann negative. Operation, February 26, 1920: Transplantation of rib cartilage with perichondrium on outer surface, through a transverse incision at situation of cross bar of spectacles. Slight infection of nasal wound resulted, coincident with the development of an ischiorectal abscess. One month later, a few drops of pus could be expressed from nasal wound, but the infection had no deleterious effect on the cartilage. Now, after 2 years, the cosmetic effect is most excellent. The nose has preserved the good appearance that it had immediately after the operation. The scar can scarcely be deciphered, and the cartilage can be felt distinctly in its original size, shape, and position, though it does not become visible in the X-ray.

Case 2. Figs. 8 and 9. (C. A. McW.) Lad, age 10, a brother of Case 1, affected likewise with congenital syphilis (Wassermann now negative), producing a more severe deformity of nose, all the cartilages and septum being gone. There was nasal obstruction and the lad was a mouth breather, because of the falling in of the alæ. The lowest inch of the nose was depressed toward the upper lip and the alæ were internally displaced. Operation, February 27, 1920: Transplantation of rib cartilage vertically through a transverse nasofrontal incision as in Case 1. There was infection of the wound, which had no subsequent injurious influence on the cartilage. Examination now, 2 years later, shows the nasal cosmetic improvement is as marked as just after the operation and the cartilage can be felt *in situ*, though it does not appear in the X-rays.

I have endeavored to have the lad allow me to perform a plastic on the right ala to lengthen it to correspond with the left ala, but he has, so far, refused. He has not arrived at the age where vanity would cause him to have it done.

Case 3. Figs. 10 and 11. (C. A. McW.) An adult man, age 24, when 15 years of age, was struck on the nose by the hoof of a horse, producing a marked saddle nose with depression of the nasal bones with consequent marked widening of the nose. Operation, April 20, 1915: Transplantation of rib cartilage through a transverse nasofrontal incision, as in Cases 1 and 2. This patient was reported in the *Annals of Surgery*, 1917, lxv, 789. Primary union. Now, 7 years later, the nose is as shapely as could be desired and the cartilage can be felt *in situ* intact, and it appears calcified in the X-ray.

PARTIAL AND COMPLETE RHINOPLASTY

METHODS OF PROCEDURE

1. The French method in which pedunculated flaps are taken from the cheeks to fill the defect. The disadvantage of this operation lies in the subsequent scarring of the cheeks. Nélaton's operation is depicted in Binnie, page 190.

2. The Indian method. In this operation a pedunculated flap is taken from the forehead and sutured to the nasal defect. The usual situation for the pedicle is between the eyebrows, requiring a twist, ordinarily leaving a hideous scar in the most prominent part of the forehead. Figure 12 shows the scar which must

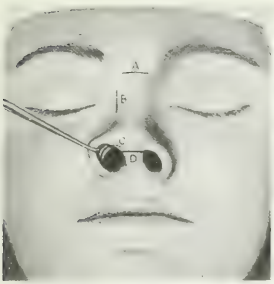

Fig. 1.

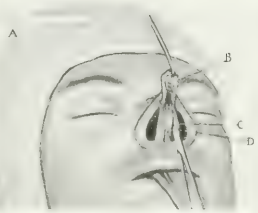

Fig. 2.

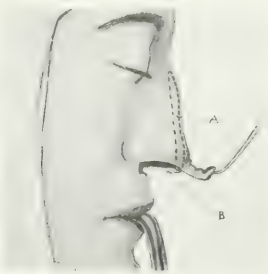

Fig. 3.

Fig. 1. Incisions (Sheehan) used for insertion of cartilage into saddle nose; *a*, infraglabellar incision preferred by the authors; *b*, inner canthus incision; *c*, ala incision for insertion of cartilage laterally; *d*, horizontal tip end incision, not the incision of choice because of the danger of infection.

Fig. 2. Method of procedure when support for the columella is to be supplied. *a*, the cartilage graft with triangular piece excised for the purpose of angulating it, the perichondrium being intact over the excised triangle to act as a hinge when bending the cartilage to a right angle, as in Figure 3. *b*, Columella hooked upward, hinged above; *c*, denuded septal membrane; *d*, cartilage of the septum, which is usually gone when this procedure is necessary (Sheehan).

Fig. 3. *a*, The graft inserted in its bed; *b*, the cartilage bent to a right angle to be covered by the columella (Sheehan).

result from such an operation. It was taken from Gillies' book, page 297. The authors maintain that for most plastics, of a severe type, on the face, including those of the nose, cheeks, chin, and lips, the high, temporal-pedicled, forehead flap, taken *within* the hair line, is by far the best because it leaves a most inconspicuous scar. The previous objection to it has been the presence of hair on the flap. Now we know that the hair can be permanently removed by the X-rays, as is seen in Case 5. After one or two applications, the hair will fall out in 1 month but will grow again. Then once a month, for 6 months, an application of the X-rays will permanently remove the hair.

Dufourmentel, in 1918, and Sebileau, in 1920, have taken hairy, temporal, forehead flaps to make up the losses of substance of the face. They can be employed to replace the upper lip, the lower lip, the chin, and the cheek, and above all, the region of the buccal commissure which is so difficult to reconstruct. It can also be made to repair the nose. It is much more comfortable to the patient than the Italian graft. By taking the temporal-frontal flap from each side, the two halves being left attached to each other in the median line, the whole upper or the whole lower lip can be reconstructed. In each pedicle is incorporated the superficial temporal artery, affording a very rich blood supply. By Thiersch-grafting the under surface before transplanting each flap, the surface of the flaps toward the mouth becomes covered with epidermis, which, being continually bathed with saliva, rapidly takes on the character of mucous membrane and does not contract. The flaps become soft and supple. On the fifteenth to the twentieth day, the flaps can be divided and the pedicles replaced in the forehead raw areas. The resulting defects in the forehead may be filled with Thiersch or Wolfe grafts. If support for the defect in the cartilaginous or bony structure of the nose is required, a piece or pieces of costal cartilage can be incorporated

Fig. 4. Shows several methods of transplanting strips of cartilage, either directly into a saddle nose or previously implanting them into a forehead flap before transposing it into nose. *a*, Transplantation of a single vertical strip of costal cartilage; *b*, implanting of three vertical strips of cartilage, the two outer ones being intended for supports for the alæ; *c*, one vertical long strip with two short lateral, transverse strips, also for supports for the alæ.

Fig. 5

Fig. 6

Fig. 7

Fig. 5. Case 1. Anteroposterior view before operation. Saddle nose, the result of congenital syphilis.

Fig. 6. Case 1. Right lateral view, 2 years after implantation of cartilage which has remained unabsorbed.

Fig. 7. Case 1. Left lateral view, 2 years after implantation of cartilage which has not been absorbed. The scar is scarcely visible.

in the forehead flap, before it is transplanted (see Figs. 4 and 14), or, if a piece of the inferior maxillary bone must be supplied, a piece of a rib, or an osteoperiosteal graft, or a bony tibial graft can be incorporated in the flap before it is transplanted. If the upper lip is to be supplied in a man, by going inside the hairy forehead, an admirable mustache can be formed.

These grafts with long, tubed, temporal pedicle render immense service in repairing losses of substance of the nose, cheeks, chin, and both lips. They should take the place of the Indian graft with a short pedicle which is often insufficient and leaves a very deforming scar (Fig. 12) and the Italian graft which is severely trying for the patient, as well as disadvantageous in transplanting skin of a different color and texture from the skin of the face. An advantage of the temporal-pedicled, forehead flap over the pure Indian forehead flap is evident when one must transplant cartilage previously in the flap, because, in the temporal flap, there is very little twisting of the flap, hence the cartilage can be more correctly placed in the flap with reference to its subsequent proper position in the nose. One may transplant a single vertical strip of cartilage, or three vertical strips, two of which go to give support laterally for the alæ, or one vertical and two lateral, small, transverse strips (see Fig. 4).

To prevent subsequent contraction of the transplanted flap, two procedures should be adopted; first, the pericranium should be left attached to the flap, and, secondly, the under surface of the pericranium should be Thiersch-grafted before it is transplanted, the pericranium being lifted up on a hinge above or below, and then replaced *in situ* after the Thiersch-grafting, where it is left for 2 weeks before the whole flap with its interposed cartilage is transplanted to its proper position in the nose. The cartilage is placed in a tunnel between the pericranium and the skin, where it is allowed to remain for 2 weeks before transplanting the whole flap, provided the result is aseptic. If forehead skin is not available, because of scarring, chest skin may be supplied by the use of Gillies' tubed, pedicle method.

Case 4. Figs. 13 to 18. (C. A. McW.) This was a girl 22 years of age, who first noticed lupus on the right cheek, 8 years ago, the size of a quarter. For 6 years she was under treatment in the Skin and Cancer Hospital, under Dr. Schuyler Clarke, of New York. The lupus had spread to the upper lip and the nose. The final result was a cure of the lupus, leaving a nose without cartilage, producing a very severe deformity. The authors feel that, in view of the present methods of improved plastic surgery, a better method of treating such a case is primarily to excise the lesions, and to do the requisite plastic operations at once. When the girl came to us, she had been apparently cured 4 years and she insisted upon operation to remove the deformity. A plaster cast (Fig. 14) was taken of the face and nose by

Fig. 8 (at left). Case 2. Saddle nose, the result of congenital syphilis.
Fig. 9. Case 2. Result 2 years after implantation of cartilage which has persisted. Most excellent cosmetic result.

Dr. V. Mitchell and on this was made a wax nose of the requisite size and shape. This new nose was an exact reproduction of the girl's sister's nose, who was 1 year younger. First operation, January 12, 1922: It was necessary to implant rib cartilage into the forehead as the first step (Fig. 13). To fix exact spot for cartilage, it was seen that the pedicle of the flap should be in front of the right ear with the superficial temporal artery in the base of the flap, and a tinfoil pattern was made of length required to cover in the new nose, large enough to go over the two sides of the nose. The requisite length of flap (Fig. 14) brought it over on the forehead about 1 inch to left of median line, its lower pole just above middle of forehead. It was planned to take about one-half the vertical diameter of flap in the hair (Fig. 15) to avoid scarring the forehead too much. Ether was given by drop method. An exact pattern of cartilage required was cut out of tinfoil. Incision was made over left, lower, costal border near sternum, and cartilage exposed. The pattern was placed on the cartilage and incisions made and a piece of cartilage with perichondrium, on outer side, was removed with the knife. The house surgeon sewed up the wound in the chest. A half-inch transverse incision was made in the forehead just where it had been previously determined that the lower end of cartilage should be situated. Tunnel made upward bluntly, superficial to pericranium, and cartilage inserted. Fine silk sutures closed the wound below. Dressing. Primary union resulted in both forehead and chest wounds.

Second operation, January 27, 1922, two weeks after first operation: Marking out and tubularization of temporal forehead flap with Thiersch-grafting of under surface of left extremity of flap. Intrapharyngeal ether. Measurements were taken, on the wax model of the new nose, of the distance required from left edge of implanted cartilage to the edge of the left ala. This was made one-quarter inch larger than necessary to allow for possible shrinkage subsequently, but this precaution was afterward seen to be unnecessary. Then this pattern, made of cellosilk, boiled, was laid on the forehead just to left edge of previously implanted cartilage and an exact flap edge was outlined, vertically, going through pericranium. This was turned transversely one-quarter inch below lower end of cartilage and was continued to a corresponding distance to right of cartilage. Then the incision curved up to hair line and then down in front of right ear. Several large spurters had to be tied. The pericranium was vertically divided at the extreme right edge of flap and was reflected up and left attached to under part of flap containing the cartilage. To the right, the flap was separated, superficially to the pericranium, from the bone, and the divided edges of flap were curled internally on themselves so that their edges were in contact, thus making a tube of them, where the edges were united by fine, chromic sutures. The part of the flap containing the cartilage with its attached pericranium, hinged above, was separated from the bone beneath, from below up. Thiersch grafts were taken from the left thigh and placed upon the *under* surface of the pericranium of this hinged flap, covering in the raw surface. Two mattress silkworm-gut sutures were passed beneath the tubed pedicle between the edges of the mobilized, forehead skin so as to draw them together, in order to diminish the raw surface, and, beneath the tubed pedicle, were placed strips of perforated cellosilk. Sterile dressing applied. The thigh wound was dressed with vaseline and gauze. No portion of the grafted cartilage was laid bare at any stage of the operation. Most of the flap was in the hair line so the hair on the transposed flap will

Fig. 10 (at left). Case 3. Lateral view of traumatic saddle nose before operation.

Fig. 11. Result 7 years after transplantation of rib cartilage, instancing persistence of the transplanted cartilage.

have to be removed by the X-rays subsequently. The flap was made in the hair so as to cause as inconspicuous a scar on the forehead as possible. It will be noticed that the cartilage implant was almost directly in the median line of the forehead, consequently an inch of the soft parts, to the left of the implant, will have to be to the left of the median line, and the question was whether the blood supply of this part of the flap would be sufficient when it should be transposed into the nose. Subsequent events showed that this doubt had no basis as the blood supply of the whole flap was perfect.

Third operation, February 10, 1922, two weeks after previous operation: Transference of forehead flap with right temporal, tubed pedicle. Perfect Gwathmey colonic anæsthesia. The nose deformity was first freshened all about into healthy tissue, going down to bone, excising all scar tissues. No nasal cartilages were found. The edges of the incisions were undermined so as to make the edges as thick as possible. The two arteries in the alæ bled profusely. The vessels were clamped but not tied as an endeavor was made not to interfere with the circulation to be established in the flap There was a perforation in the septum, one-quarter inch back. Two vertical incisions alongside the columella were made with one upper, transverse one going through the perforation, thus freeing the columella, from the raw end of which there was a small spurter, showing that its blood supply was good. A pattern had previously been cut out of cellosilk, of the size of the wax model of her sister's nose, so as to get size and shape of the left side of the desired nose. This pattern was laid on the left edge of the three-quarters previously marked out frontal flap, which, when it had been lifted up, was seen to be beautifully covered on its under surface by the Thiersch grafts which had taken *per primam in toto*. Flap cut out from forehead was left attached to its tubed pedicle to right. Such a thick forehead flap does not shrink perceptibly so that it is not necessary to cut it longer than desired. This flap edge was cut to fit the angle of the left ala. Silk sutures were passed

Fig. 12. From Gillies. Illustrating disfiguring scar which must result from this short, twisted, Indian method forehead pedicle in the most conspicuous portion of forehead.

between the ala and the flap, and interrupted sutures along the left edge and above across the root of the nose. At the junction of the columella and the flap, a notch was cut in the flap, and into this notch the upper raw surface of the columella was fitted and sutured. The suturing was continued around half the right side of the two edges of the right ala up to where the pedicle became attached. The raw surface of the right ala was sutured to the under raw surface of the flap. The final result was good. The flap did not change color after being transferred, and, as its edges bled, the circulation was assuredly sufficient. The edges of the frontal defect were undermined and brought partially together with three mattress sutures upon each of which fine rubber tubing was placed. The raw defect was covered with perforated cellosilk and a sterile dressing was applied and bandaged on. After the operation, an electric light was placed in front of the nose, attached to a cradle, to provide heat to the flap. The colonic anæsthesia was perfect, the patient was quiet with no vomiting. The operation lasted about one and one-half hours and was most satisfactory from all standpoints. The observation was confirmed that transplanted cartilage tends to bend toward the perichrondial side. It was so in this case. As soon as the flap containing the cartilage was freed the cartilage seemed to curve with lower end forward.

Fig. 19

Fig. 20.

Fig. 21.

Fig. 19. Case 5. Cure of epithelioma of nose by radium but with resulting deformity. The mid-cartilage of the nose has remained intact.

Fig. 20. Case 5. Tubed, right, temporal-pedicled, forehead flap, taken within the hair line, reflected into the nose.

Fig. 21. Case 5. Side view of final result.

This, it is hoped, will counteract any tendency for the cartilage, in the nose, to bend toward the cavities. Two weeks after the flap was transplanted, a smooth stomach clamp was applied, three times a day for an hour at a time, to a quarter of the vertical diameter of the flap just to right of nose. Gradually increasing amounts of the flap were taken in by the clamp each day until the whole vertical diameter of the flap was grasped by the clamp, three days before the flap was totally divided In Figure 16, one can see the furrow caused in the flap by the clamp. Fourth operation, March 3, 1922, three weeks after the third operation: Severing and replacement of tubed, temporal flap. Rectal anæsthesia very satisfactory. Flap divided vertically through its whole extent along margin of right ala. More profuse bleeding from the cut nasal edge than from the pedicle end. The whole extent of the flap had become attached behind to the cut ala edge. Skin of cheek along the ala edge incised and undermined along cheek. The flap was very thick, connective tissue having evidently formed in it. So the entire fatty layer was excised, extending almost to the cartilage and with it some connective tissue. All the tissue that was possible was excised. Then fine silk sutures were passed between the skin edges of ala and flap. Result was excellent.

In the meantime Dr. Dunning had proceeded with replacing the freshened forehead flap. The tubed edges were divided and all granulation tissue was removed from the whole flap. The excessive granulation tissue of the forehead defect was scraped away and its edges were undermined. The flap was stretched and sutured edge to edge in position with interrupted silkworm mattress sutures, leaving an area to the left 1.5 inches transversely, and 1 inch vertically, to be Thiersch-skin grafted. These grafts were then at once taken from the right thigh. Perforated cellosilk was placed over forehead grafted area. Sterile dressing with bandage was applied. These grafts applied directly to the bone took *per primam in toto*.

Fifth operation, March 13, 1922: Retouching of edges and reduction of both sides of cartilage. At patient's request a very satisfactory colonic anæsthesia was administered. There was a prominence just below the upper scar, due to a projection of the implanted cartilage. This was clearly evident in a roentgenogram. An incision was made through the upper part of the old scar on the right side of the nose. The skin was lifted up and the cartilage exposed. The perichondrium was stripped from it and about one-quarter inch of the cartilage was obliquely divided with a knife in a direction from below upward, and from before backward. Then some of the lateral, subcutaneous tissues were removed with knife as the flap was too thick, and a little of the edge of the skin was excised as the skin was redundant. Mattress silk sutures were inserted. Below the tip, the cartilage was exposed by one-quarter inch transverse incision, and one-sixth inch of the cartilage was removed. Two silk sutures were inserted. The columella below was too prominent so its posterior surface was denuded of tissue at its lower part and also a corresponding part of the septum. Two silk sutures were inserted between the septum and the columella, so as to bring the columella backward. The flap, corresponding to left ala, projected posteriorly over cheek, so an incision was made through the old scar and a cavity was made under the skin of cheek to bring the cheek edge out. This cavity was filled by a piece of cartilage, previously removed from the base of the cartilage. Two silk sutures closed the edges which were brought together in good approximation. Primary union resulted. The final result was excellent. The nasal passages were free and dry and healed, being lined with healthy skin. The girl was immediately placed under X-ray treatment by Dr. Samuel Stern to remove the hair from the transplanted skin of the

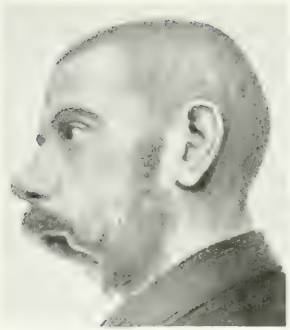

Fig. 22.

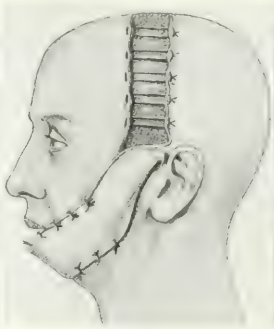

Fig. 23.

Fig. 24.

Fig. 22. Complete loss of chin, the result of gunshot wound.

Fig. 23. Method of repairing injury in Figure 22 by bilateral, attached, tubed, temporal-pedicled, forehead flaps. In this flap may be previously implanted cartilage or bone, if found necessary.

Fig. 24. Result in case shown in Figure 22 after severing and replacing the pedicles in temples.

nose. On November 1, 1922, the cosmetic result is all that could be desired. There has been no contraction of the transplant, the hair has not recurred and there are no telangiectatic changes in the skin.

A fact that this operation brought out was that with a single, temporal flap, one need have no fear of gangrene of the flap if one goes beyond the opposite, median line of the forehead, because of the extraordinarily rich blood supply provided by the contained superficial temporal artery. A second fact was that flaps made of the whole thickness of the scalp, particularly if the pericranium be included and skin-grafted on its under surface, do not shrink. A third fact was demonstrated in the very successful colonic anæsthesia administered to this patient three times. Its use should be more widely extended in operations about the neck and face. We have heard of fatalities with its use; but in the Skin and Cancer Hospital, where it has been given at least three hundred times without any disadvantageous effects, it has never caused an unquestioned accident. May not attempted modifications of Gwathmey's method be responsible for bad effects?

Case 5. Figs. 19, 20, and 21. (H. S. D.) In May, 1918, patient noticed a small pimple on the left nares, which gradually increased in size, ulcerated, and eventually involved both right and left nares. He was treated privately until about December, 1919, at which time the lesion was cauterized with electric needle and he had emanations of radium. Following this, the ulceration healed, leaving defects of both nares. Examination of pathological specimen by Dr. W. J. Clark, showed epithelioma.

At the time of admission to hospital, November 20, 1920, patient showed loss of the right and left nares to the extent of about one-half inch on each

Fig. 19. First four pictures show method of repairing the difficult commissure defect. Last three pictures show method of making a new upper lip provided with a mustache.

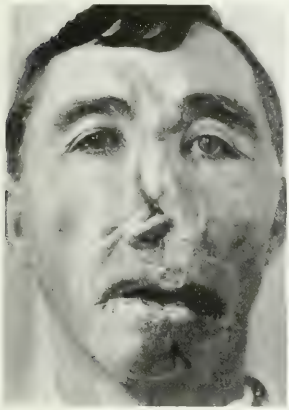

Fig. 26.

Fig. 26. Case 6. Full face showing total wiping off of face of nose with only portion of right ala left of the tip. All the structures of nose must be supplied. In this case left ring finger was used, but a much better method is to use a tubed, temporal-pedicled, forehead flap with preliminary implanting of costal cartilage.

Fig. 27.

Fig. 27. Case 6. Before operation. Traumatic wiping off face of whole nose.

Fig. 28.

Fig. 28. Case 6. Full view of new nose shortly after final operation. The cosmetic result is inferior to that which could be obtained by the then unknown temporal-pedicled, forehead flap.

side. The cartilage of the nose was present, and was covered with thick fibrous tissue. Scar tissue was present from the tip of the nose up to the juncture of the cartilaginous and bony portions of the bridge of the nose. The ala nasi were present on both sides. The mucous membrane of the nose was lost for about one-fourth inch above the lowest edge of each side of the nose.

Patient was operated on December 16, 1920, at which time tubed, temporal pedicled, forehead flap from the right side of the head in the hair line, was outlined and extended from the zygomatic arch upward to about the midline of the scalp. This was dissected free down to pericranium (but not including it) and tinfoil inserted beneath the entire surface, carrying a Thiersch graft of about 2 inches on under the surface of the flap to line the nose. The proximal half of the flap was tubed, both ends being left attached. Following this the superior end of the flap was cut in half.

January 11, 1921, a second operation was performed, the superior end of the flap being cut. Scar tissue was dissected free over the tip of the nose and the forehead flap brought down and the free end of the flap sutured along the left side of the dissected surface of the nose.

February 5, 1921, releasing of the flap on the right side of the nose and suture of the graft to the bed of the right side of the nose. The pedicle was also returned to its former bed and granulating surface on top of scalp, left to granulate.

February 10, 1921, Thiersch graft of granulating surface on top of scalp.

October 20, 1921, and November 2, 1921, minor plastic corrections along the suture line made.

In the interim between February, 1921, and October, 1921, patient had three applications of X-ray with view to destroying hair on the graft.

Fig. 29. (at left). Case 6. Finger denuded of nail was sutured into the nasal defect and held in this position for 3 weeks by a plaster helmet.

Fig. 30. Case 6. After amputation of finger at mid first phalanx. First phalanx was then turned anteroposteriorly.

Practically all hair has been removed, and the patient has not been troubled by any return of same. There is no telangiectasis in the skin.

Other plastics of face by tubed, temporal-pedicled forehead flaps. Figure 22 is a picture of a man who has lost his chin in a gunshot accident. Figure 23 shows an excellent method of repairing the defect in Figure 22, by bilateral, attached, tubed, temporal-pedicled, forehead flaps in the hair line. Figure 24 shows the result obtained after severing and replacing the pedicles in the temples. Figure 24 gives the result after the hair has grown on the transplanted chin.

Figure 25 illustrates the method used in repairing the difficult commissural defect and of forming a new upper lip with a new mustache also provided.

THE ITALIAN METHOD

In the Italian method the skin for the repair of the nasal defect is taken from the inner and anterior aspects of the arm. The objections to this are: first, that the arm must be maintained in a very trying position for 2 or 3 weeks; second, that the skin of the arm is of a different color and texture from the skin of the nose and cheek; third, that there is greater liability to infection, as the distance to be bridged and tension are greater with a poorer blood supply than with the temporal-pedicled flap, in addition to which there is greater difficulty in maintaining cleanliness under the flap, hence the greater danger of gangrene of the flap; and, fourth, the impossibility of epithelizing the under surface of the flap properly. If a flap is not provided with epithelium and is allowed to cicatrize, contraction is bound to occur, defeating the whole purpose of the operation. The Italian flap is being less and less frequently employed in face plastics and should be ordinarily replaced by the temporal-pedicled forehead flap. Where this latter method is impossible because of previous scarring, the skin of the chest should be used, following Gillies' tubed, pedicled method.

THE FINGER OPERATIVE METHOD

In the finger operative method a portion of one of the left fingers is transplanted to make up for the nasal defect. The cosmetic final results are poor. One of the authors has done one of these operations, but he will never do another by this method.[1] There are but few operators who have used the procedure a second time. Finney is the only operator we know of who has reported a second case. The tubed, temporal-pedicled forehead flap method, with or without previously implanted cartilage, is infinitely superior in its results and much easier both for the operator and for the patient. Another disadvantage of the finger operation is the consequent blocking of the air passages caused by the width of the phalanges.

Case 6. Figs. 26 to 30. (C. A. McW.) Reported in full in the *Journal of the American Medical Association*, March 8, 1913. An adult had lost his entire nose, years before, in an accident in a stationary engine. The left ring finger was used to replace the lost nose. The cosmetic result was only fair. The authors feel that a much better procedure is to make a new nose out of a temporal-pedicled forehead flap into which cartilage has previously been transplanted. This man died 2 years after transplantation, of pneumonia.

For the excellent photographs, we are indebted to Mr. C. J. Lander, of the Presbyterian Hospital, New York.

[1] Am. M. Ass. 1912. March

PARATHYROID HYPERPLASIA AND BONE DESTRUCTION IN GENERALIZED CARCINOMATOSIS[1]

BY PAUL KLEMPERER, M.D., CHICAGO

THE function of the ductless glands and their relation to various diseases form a fruitful field for investigation in experimental medicine. Anatomical observations have often given the first suggestions to the experimental worker as to the importance of various organic changes in the pathogenesis of some of the obscure diseases, and thus it has laid the foundation for the further advance of our knowledge in this direction. However, our knowledge of the function of the ductless glands has been developed largely by means of experimental work. To morphological pathology, however, another problem has been left: This is to corroborate our knowledge of the function of the ductless glands, founded by experiments on animals, through the postmortem findings in the human body. Efforts in this direction are partly retarded by the deficiency of our knowledge of the finest morphological changes with which changed organic functions may be associated; partly, however, more external causes are to blame, namely, the relatively small number of cases which come to the pathologist for study. From this point of view the report of the following case seems justifiable, in that it may fulfill, in a certain sense, the above mentioned claim.

The patient, a female 49 years of age, entered the hospital in September, 1920. Both mammary glands had been removed with a diagnosis of cancer, 18 months previously. Six months before entering the hospital the patient had pains in the back. These became gradually worse and she entered the hospital complaining of these pains. The patient was very anæmic and cachectic; on physical examination she complained of pain over most all body structures, especially in the spinal region. The X-ray examination showed multiple cancer metastases in the whole skeleton.

Blood findings on entering were red blood cells 2,100,000; white cells 3800; hæmoglobin 18 per cent; color index, below 1. This decreased to 1,000,000 red blood cells, hæmoglobin 14 per cent before death. In smears poikylocytosis and numerous normoblasts were present. The latter frequently showed disintegration of the nuclei and peculiar nuclear forms resembling clover leaves. The differential counts of

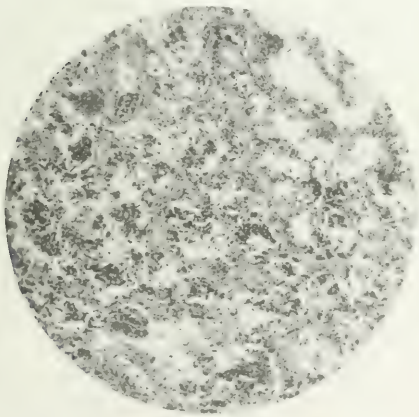

Fig. 1. Metastasis in the lung composed of irregular glandular formations and solid tumor cell nodules.

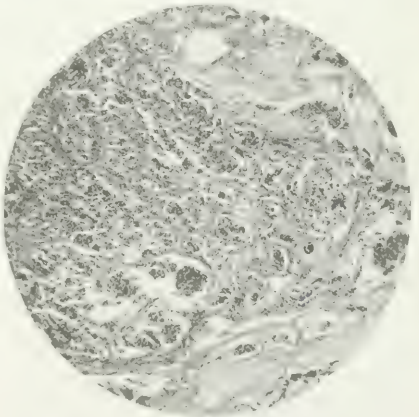

Fig. 2. Metastasis in the vertebra, almost complete destruction of bone tissue.

[1] From the Pathological Department of the Loyola University School of Medicine

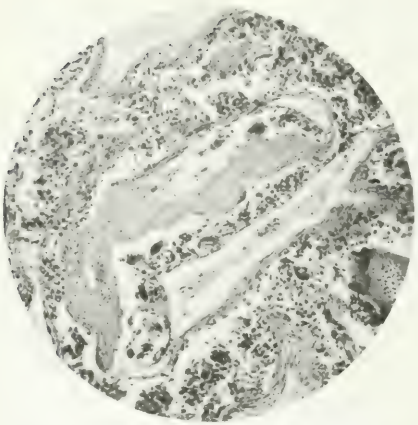

Fig. 3. A trabeculum with Howship's lacunæ and osteoclastic giant cells.

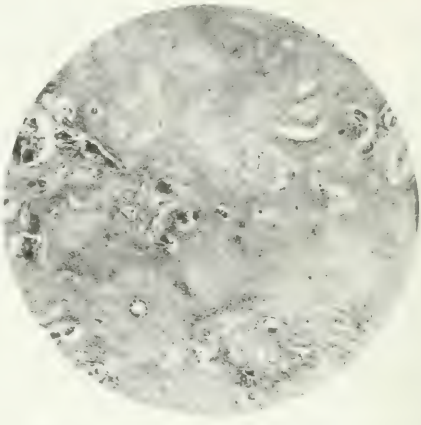

Fig. 4. New formed osteoid tissue, probably of metaplastic origin from connective tissue.

the white cells were practically within normal ratios. Only a few large mononuclear cells could be seen which were recognized as neutrophile myelocytes.

The urinary findings were negative.

With increasing cachexia the patient died after a 3 months' stay in the hospital.

At the autopsy scars were found caused by the removal of both mammary glands with a radical resection of the axial lymph glands. In both lungs numerous tumor nodes were present. The most significant condition, however, was the state of the skeleton. The spine in its whole extent could be cut easily with the cartilage knife, in the right femur, there were larger and smaller nodules narrowing the cortical substance, while they destroyed the spongy substance of the bone in the epiphysis. There were also metastases in the cranial and in the sternal bones.

The extensive destruction of bone tissue occasioned an examination of the parathyroid glands. On dissection three were found in the normal place; they seemed to be unaltered in their size. Instead of the left inferior parathyroid gland I found an oblong, kidney-shaped body 30 by 5 by 3 millimeters in size, entirely separated from the thyroid gland. It was yellow in color, and dense in consistency.

The pituitary gland was taken out as usual in every case of mammary cancer; it seemed to be of normal size and was preserved without dissection. I took parts of the lung metastases, spine, all glands of internal secretion and, of course, the tumor in the parathyroid area for further histological examination.

The histological examination of the lung metastasis revealed an adenocarcinoma of highly anaplastic structure composed partly of irregular glandular formations, partly of solid tumor cell nodules.

In sections through a vertebra we found areas with an almost complete destruction of the bone which was replaced by an extensive growth of cancer cells. On other places we could recognize the way the bone was destroyed. The destruction was brought about to the greatest extent by formation of Howship's lacunæ in which numerous giant cells were found. Here and there we saw columns of carcinoma cells invade the lacunæ but we could not find giant cells in these places. Such pictures might suggest the possibility of bone destruction by the cancer cells without osteoclasts. In other places of the slides we found, instead of the normal bone, an extensive formation of a fibrous tissue and osteoid tissue enclosing the rest of the bony trabeculæ. The development of the osteoid tissue could be observed only in a few places and seemed to be rather dependent upon a metaplastic origin from connective tissue than on osteoplastic activity

Thus the histological picture of the bone metastases revealed not only an extensive bone destruction but also a noticeable new formation of osteoid tissue. The outstanding differences between the bone lesions in our case and the ordinary lesions in mammary and prostatic cancer, consist in the former of a complete absence of calcification of the newly-formed osteoid tissue. This appearance agrees in a certain sense with the bone condition in osteomalacia and justifies the name "osteomalacia carcinomatosa."

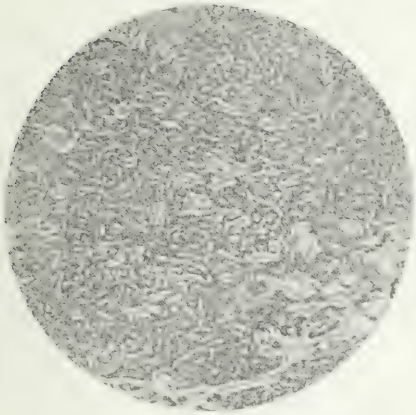

Fig. 5. The parathyroid hyperplasia (low power).

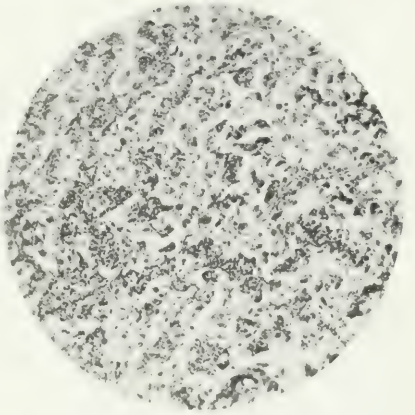

Fig. 6. Showing tumor cells among the "chief cells."

On histological examination the parathyroid glands were found to be formed mostly by cell cords; partly, however, they exhibit an alveolar structure. On further examination we found that this tissue was formed by a fine connective tissue with numerous blood vessels forming the framework for two different types of cells. The majority of the cells were of medium size with large nuclei and the cytoplasmic zone was usually narrow. Within this group small differences can be found among the cells in regard to the amount of cytoplasma and chromatin in the nuclei. Differences that are not very conspicuous do not justify a further classification. It rather seems proper to class together all these cells and to compare them with the known cells of the parathyroid glands. In this instance we are entitled to conceive these cells as the "chief cells." The other type consists of larger, sharply defined cells which differ from the above described cells by their copious, dark red stained cytoplasma and their small, very deeply blue stained nucleus. These cells lie partly between the "chief cells," partly, however, they form small alveoli containing occasionally colloid. These cells correspond to the so-called "oxyphile" or "Welsh's cells." The tumor of the left inferior parathyroid body showed in sections the same structure as the three parathyroid glands and was built up by the same cells. The structural differences within the "chief cells" were also present. The eosinophile cells were collected in large groups. In two areas we found small tumor cell nodules, one focus located just in a group of eosinophile cells.

Since the tumor was unquestionably formed by parathyroid cells the question arose as to whether this formation was a real parathyroid-tumor or merely a hyperplasia. From a histological standpoint it seems justifiable to conceive it as a real hyperplasia, since it is composed equally of both kinds of the cells of parathyroid glands, yet not exhibiting an overgrowth of any one type of the cells. Maresch (1) gives a description of tumor-like hypertrophia of parathyroid glands which fully corresponds to our findings. He points out that the characteristic histological picture of hyperplastic parathyroid gland is "an increase in the size of the chief cells and their nuclei, various degrees of compactness of their cytoplasma, alveolar formation with a colloid-like content, extraordinarily large accumulations of large and small eosinophile cells."

Serial sections through the pituitary gland revealed that the posterior lobe and the intermedial zone were almost fully destroyed and replaced by tumor growth, whereas the anterior lobe was not involved, and its cellular structure seemed entirely normal.

Tumor metastases were found in the thyroid gland and in the left ovary. The pancreas and adrenal organs were free from metastases and showed a normal appearance.

Discussing these histological findings, we wish to call attention at first very briefly to the fact that a complete destruction of the posterior lobe of the pituitary gland did not lead to any changes in the amount of the urinary secretion. This fact seems to justify the statement established by Leschke (2) and accepted later by the majority of the physiologists that the posterior lobe of the pituitary gland does not regulate the water excretion. In regard to the statement that a nerve center

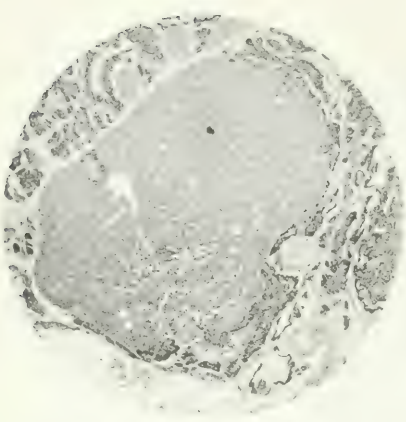

Fig. 7. A group of eosinophile cells.

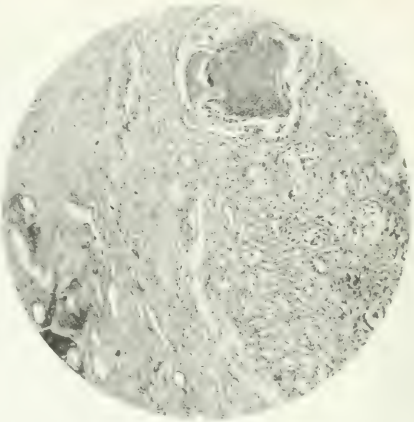

Fig. 9. Thyroid gland with metastasis.

in the floor of the third ventricle is responsible for this regulation, we may mention that the anatomical examination did not reveal any changes in this region in the case here described.

Fig. 8. Pituitary gland. The posterior lobe destroyed by tumor masses.

The most interesting question, however, is the relation between the extensive bone destruction and the parathyroid hyperplasia. Briefly reviewing the literature, we mention the first paper by Erdheim (3) who found hyperplasia of the parathyroid glands in 6 cases of osteomalacia. These findings were confirmed in the next few years by Strada (4), Bauer (5), Schmorl-Todyo (6) and others. These observations were extended by Maresch (1), Meyer (7) and Hartwich (8) to other conditions of bone destruction, such as osteitis fibrosa and osteoporosis. The extensive bone destruction, however, in bone carcinomatosis has not heretofore been considered and our case is the first in which an examination of the parathyroid glands has been made.

In a discussion of an enlargement of the parathyroid bodies we have to consider, as Maresch pointed out, whether the overgrowth represents a real tumor or a tumor-like hyperplasia. In the latter instance we would expect bony changes, but not in the former. The enlargement in this case proved histologically to be a real hyperplasia because of its complete resemblance to the three parathyroid glands in its structure. One is therefore entitled, I presume, to bring it in rela-

tion to the bone destruction. The question whether hyperplasia of the parathyroid glands is to be considered as the cause or as the result of the disturbance of the calcium metabolism, cannot be answered definitely.

The majority of writers, however, favor the latter conception that the hyperplasia of the parathyroid glands is to be interpreted as an increased functional activity tending to compensate for a disturbed calcium metabolism. In our case there is no doubt that the bone destruction is due to the carcinomatosis and this fact could better support the above-mentioned assumption than any other observation. The question, however, remains why the calcification of the newly-formed osteoid tissue failed to appear. If the extensive bone destruction with the extreme deprivation of calcium called for a compensatory hyperfunction of the parathyroid glands and if this hyperplasia really means hyperfunction, it seems remarkable that one does not find any trace of calcium deposition in the newly-formed osteoid tissue. Such a consideration induces the conception that the hyperplasia of the parathyroid glands is by no means synonymous with a hyperfunction. I would rather consider it as a fruitless attempt of the body to compensate for the calcium deficiency and conceive the hyperplasia as the structure of a hypofunctioning gland. The characteristic picture of a hyperactive parathyroid gland is not known as yet. Tomaszewski (9) attempted to find noticeable changes in the parathyroid glands in instances of larger calcium deposition in the body. He claimed an increase of the eosinophile cells and a formation of follicles with colloid as a sign of an increased function. Considering, however, that a calcium deposition as in calcified ribs, atherosclerosis, or calcified tuberculosis is not to be considered as a very extensive one, I doubt whether his conclusions can be applied to this case. Perhaps one would recognize the feature of a hyperactive parathyroid gland if he examined the glands in cases of prostatic or mammary cancer with extensive osteoplastic metastases, a condition which is combined with an entirely changed calcium metabolism, involving both destruction and an accumulation to a very high degree.

The predominance of osteoplastic changes in prostatic cancer metastases and of osteoclastic changes in thyroid cancer metastases are well known facts. If the parathyroid glands were carefully examined in all cases of bone metastases, it is possible that some light might be thrown upon this obscure process.

I publish this report, conscious of its incompleteness; but because of lack of autopsy material at my disposal at the present time, I hope it will stimulate others who have better opportunities, to continue these observations.

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UNILATERAL DIURESIS[1]

By ANDREW FULLERTON, C.B., C.M.G., Belfast, Ireland

I HAVE chosen the title "Unilateral Diuresis" for this communication on account of its convenience, although it hardly covers the substance of my remarks, which will deal with differences in the specific gravity of the urine on the two sides in certain surgical affections of the kidney. In some renal disorders there is what I may term an active or acute diuresis, or an increased activity of the normal kidney function: in others the kidney is more disabled, and its function is confined in the main to the process of filtration. This may be called passive or chronic diuresis. There is a third class, in which much destruction of kidney substance has taken place, and the urine secreted is not only diminished in specific gravity but reduced in quantity.

Cushny,[2] who is mainly responsible for what he terms the modern view, thus shortly summarizes the two rival theories of urinary secretion. Bowman's theory as elaborated by Heidenhaim regards "the glomerular capsule as normally secreting a dilute fluid not far removed from a deproteinized lymph in constitution. This fluid as it passes down the tubules carries with it the products secreted by their walls, such as urea, uric acid, and salts, and issues in the collecting tubules as the normal urine." The modern view states that "the function of the kidney may be shortly defined as the filtration of the non-colloids through the capsule and the absorption of 'Locke's fluid' through the tubule cells. The capsule furnishes the tubules with the fluid as it exists in the circulation, the tubules return to the blood the fluid best adapted for the tissues, and allow the rest to escape in the urine."

In diuresis the fluid is hurried through the tubules, and time is not allowed for taking up the products secreted by the tubules, according to the older theory, or for reabsorption of fluid, according to the modern theory. The result is a dilute urine of low specific gravity. Cushny says that the composition of this urine is that common to all forms of diuresis—more abundant chloride, less marked acidity. Further research on the chemical composition of the urine is necessary in surgical affections of the kidney. In chronic cases the percentage of chloride may be much diminished.

A good example of active or acute diuresis is that occurring in hysterical or nervous persons. A large quantity of pale, limpid urine of low specific gravity is secreted. A familiar example of passive or chronic diuresis is afforded by obstructive conditions of the urinary outlet, such as enlarged prostate. Here the quantity of urine passed in 24 hours may reach 7 to 10 pints or more, and the specific gravity may be 1005 or under.

The object of this paper is to establish the importance of diminished specific gravity of the urine on the affected side as a sign of unilateral disease of the kidney or disturbance of its function. For many years I have been interested in the specific gravity test in surgical affections of the kidney, and have made, up to the present, 448 observations. In all cases a double catheterizing cystoscope was used, and the specimens in each were taken at the same time, and as far as possible under the same conditions as regards the size and shape of the ureteral catheter and the distance along which it was passed into the ureter. All specimens taken at different times, and those which contained much blood or thick pus, were discarded. The specific gravity was taken with glass beads registering from 1005 to 1030. Obviously this is a rough and ready method, but I have found it convenient for practical purposes. In a few cases more exact methods were employed. Before taking the specimens for examination, time was allowed for the discharge of a number of jets, until it was judged that the disturbance caused by the introduction of a foreign body into the ureter had subsided. A temporary

[1] [illegible] American College of Surgeons, Boston, October 21, 19[illegible]

anuria is frequently produced by the mere introduction of the catheter, and time must be allowed for this to pass off. On the other hand, in a nervous patient the urine first collected may be very watery and of low specific gravity, and one must wait until the patient has become calm, so that as normal a secretion as possible may be obtained. It is not uncommon to find the specific gravity increase, and the quantity emitted in a given time diminish during examination in such cases. Notwithstanding all the difficulties associated with procuring a typical specimen in a given case, care and patience will be rewarded by obtaining results of much value in diagnosis.

In order to estimate the significance of variations of the specific gravity on the two sides it is important to ascertain the conditions present in health. It is, of course, impracticable to examine perfectly healthy individuals, and fortunately, this is not necessary, as many patients suffering from obscure symptoms are glad to avail themselves of any means likely to clear up difficulties in diagnosis. I have examined 117 patients in whom all the evidence, after careful cystoscopy, was against a renal origin of their complaint. These cases appear in my notebook under such headings as "pain in the back or side," "frequency of micturition for which no cause could be discovered in the urinary system," "oxaluria," "phosphaturia," "urethral caruncle," "dysuria," "abdominal pain," "abdominal tumor," "affections of the uterus and ovary," "affections of the gall-bladder and bile ducts," "enlargements of the spleen and liver," "extra-uterine pregnancy," "colitis." "vague aches and pains," "neurasthenia," "cystitis," "ulcers and tumors of the bladder without involvement of the kidney," and in 111 out of the 117 the specific gravity was equal on the two sides. I am not certain that, after all, there may not have been some disorder of the kidney in the six exceptional cases. Two were cases of cystitis, and it is possible that a previous unilateral pyelitis had cleared up, leaving some disturbance of function on that side. In addition to these normal cases some cases of bilateral disease of the kidney were examined, with the following results. In 10 cases of nephritis without obvious hæmaturia the specific gravity was equal on the two sides. Out of 26 cases of bilateral pyelitis the specific gravity was equal on the two sides in 21. In the remaining cases my notes record that the condition as shown by the amount of pus and albumin was more severe on the side of the lower specific gravity. All this goes to prove that a difference in specific gravity on the two sides indicates some abnormal condition on one side, or, if both kidneys are diseased, an inequality in the extent of the involvement on the two sides. I have found that in the following groups (with certain exceptions) a lowered specific gravity is found on the affected side: renal calculus, tuberculosis of the kidney, tumors of the kidney, unilateral pyelitis, hydronephrosis, polycystic disease of the kidney in which one side is more involved than the other, hydatid cyst of the kidney, movable kidney, renal colic, renal infarcts, gunshot wounds of the kidney, and some cases of symptomless renal hæmaturia.

RENAL CALCULUS

Forty-eight cases were examined. Thirty-two of them were verified by operation; in 9 cases calculi were passed, and in one several small stones were discharged through a sinus in the loin. Four cases were bilateral, and in 3 the patients were examined shortly after the calculus had escaped from the ureter. This leaves 41 cases of unilateral renal calculus examined while the stones were in position. In 31, or over 75 per cent of them, the specific gravity was diminished on the affected side. In about half, the specific gravity was as low as 1005 or under on the affected side, as against 1015 to 1025 on the sound side. In 2 cases the specific gravity was a little higher on the affected side, and in the remaining 8 it was equal on the two sides. In some of these cases of renal calculus we have typical examples of what I have termed active or acute unilateral diuresis, i.e., rapid flow of urine of low specific gravity, on the affected side. The following are examples.

A man, aged 55, was examined in one of the intervals between his attacks of left-sided renal colic. The left ureter was very active and discharged watery urine, specific gravity 1005, faintly acid,

without deposit, free from pus, but containing a trace of albumin. The right ureter discharged, with less activity, urine of a deep amber color, specific gravity 1025, sharply acid, depositing urates on standing. A day or two later he passed a small calculus. Subsequent X-ray examination showed the kidneys clear.

A woman, aged 32, suffering from repeated attacks of right-sided colic, was examined during an interval. The right ureter discharged as many as 20 drops at a time through the ureteral catheter, with intervals varying from 5 to 15 seconds, and at other times only a couple of drops with each efflux. The left ureter discharged about 5 or 6 drops every 15 seconds, and was more regular in rhythm, and in the quantity emitted. The specimen from the affected side was almost colorless, neutral in reaction, specific gravity under 1005, and contained pus and albumin. That from the sound side was amber in color, acid in reaction, specific gravity 1010, and free from any abnormal constituent. The calculus was subsequently passed.

As leakage by the side of the catheter is liable to occur in all cases of ureteral catheterization, too much dependence must not be placed on the exact amount collected by this means. The following bilateral case is instructive.

A woman, aged 47, had had pain in the right loin which passed off, to be succeeded some years later by pain in the left which culminated in an agonizing attack of colic a few days before I saw her. Urine could be seen issuing from the right ureter but no flow could be detected from the left. The ureteral catheter could be passed only about 2 inches into the left ureter. (X-ray had previously shown a small shadow in this position and a definite calculus in the right renal pelvis.) Indigocarmine injected into the buttock came through in 15 minutes on the right side, but no flow could be seen on the left, not even by the side of the catheter. The tint of the specimen from the right ureter was much paler than normal, and remained so until it finally disappeared 26 hours later. The pain had become fixed in the left iliac region after the last severe attack of colic. A week later a small irregular oxalate calculus was passed and all pain disappeared. Cystoscopy was carried out the same day. Indigocarmine of a deep blue color now appeared on both sides in 10 minutes. The flow from the left side was now active and the specimen collected had a specific gravity of 1010, and was free from pus and albumin. The specimen from the right ureter contained blood, pus, and albumin, and had a specific gravity of 1015. Later I removed a phosphatic calculus from the right renal pelvis, which showed signs of commencing hydronephrosis.

A study of these 3 cases is very interesting from the point of view of the physiology of anuria on the one hand, and polyuria on the other. Surgeons have long been acquainted with reflex anuria as the result of the irritation of a renal calculus. The third case mentioned above shows that anuria on the side of the calculus causing most irritation may occur. The calculus was too small to cause a complete block of the ureter, but not only was there anuria on the side of the pain, but the function of the opposite kidney was to some extent interfered with as shown by the delay in the appearance of indigocarmine and the pale color of the specimen maintained during the 26 hours of its elimination.

While much has been written on unilateral and bilateral anuria, very little has been said of the occurrence of unilateral diuresis,[1] from whatever cause produced. My own experience is that unilateral diuresis is a much more common result of renal calculus than anuria. The explanation of both phenomena is afforded by a study of the nerve supply to the kidney, and its influence on the blood flow. Through the splanchnic the kidney receives vasoconstrictor and vasodilator fibers. The stimulus of a calculus in kidney or ureter may cause vasoconstriction and reduction or cessation of the secretion of urine on that side, due to diminished blood flow through the glomeruli. On the other hand, it may cause vasodilation, increased blood flow, and diuresis. My observations lead me to believe that the latter is the more common occurrence.

Professor Cushny in a recent letter to me on this subject states: "There may be two constrictor effects, one on the afferent vessels of the glomerulus which would reduce its blood supply and lessen the filtration, another on the efferent vessels from the glomerulus which would raise the pressure in the glomerulus and thus cause diuresis." He says: "This constriction of the efferent vessels, while increasing the glomerular filtration, might very well lessen absorption in the tubules through lessening the oxygen supplied to the cells."

I have not noticed that in the form of diuresis we have been discussing there is any notable increase in the daily output of urine, although these patients often complain of frequency of micturition during the attacks

of pain. An increase on one side may, therefore, be associated with a corresponding diminution on the other. Further observations on this point are necessary.

The effect of the calculus on the secretion of urine may be due to pain, but I have seen the same phenomenon when pain was entirely absent. Cushny discusses "pressure diuresis" seen in animals when one ureter is slightly obstructed, and states that it is almost certainly due to a reflex vasodilation, and disappears at once when anæsthesia is deepened. He suggests that a slight stimulus arouses a dilator effect while a stronger one, such as the pain of a calculus, sets the more powerful constrictor in action and this leads to anuria. My observations do not sustain this view. The stimulus produced by a calculus is certainly in many cases very severe, and yet diuresis is the more common effect.

There were 2 cases of renal calculus in which the specific gravity on the affected side was higher than on the sound side. In both, operation showed evidence of some obstruction. In these cases the effect of the obstruction may have been to delay the urine in the tubules, and allow of its greater concentration. Cushny, explaining the results of obstructing the ureter in animals, says that the pressure in the ureter opposes the filtration pressure in the capsule and a low resistance may reduce the amount of filtrate considerably. The smaller amount of filtrate passes more slowly along the tubules and more time is allowed for the reabsorption of water and sodium chloride. These experiments and their explanation throw much light on the findings in the cases I have mentioned, but it is difficult to see why the same cause should produce at one time reflex diuresis and at another increased concentration of the urine.

I have had the opportunity of examining at operation many kidneys in which small calculi had produced the diuresis to which I have referred. These kidneys have appeared to the naked eye sound in every respect. In addition I have had occasion to cystoscope a few patients either after the passage of a stone or after operation for its removal, and have found a rapid return to the normal. In cases of renal calculus which have lasted some time, and in which organic changes in the kidney have taken place, the specific gravity of the urine is still low. This is the more chronic or passive form of diuresis. Later the amount of urine on the affected side diminishes as the functional area of the kidney is reduced, until finally the latter becomes obsolete and no excretion whatever takes place. In such cases ropes of pus may be squeezed from the ureteric orifice. Occasionally a perirenal abscess forms and bursts, or is opened and calculi are extruded.

TUBERCULOUS KIDNEY

Forty-one cases of tuberculous kidney were examined. Three of these were bilateral and had an equal specific gravity on the two sides. One case, which was unilateral, had a low specific gravity, 1005, on both sides. In all the remaining cases the specific gravity was reduced on the affected side. This gives a percentage of 97 showing diminished specific gravity on the side affected.

The urine on the affected side is usually pale, slightly acid or neutral in reaction, increased in quantity, and contains pus and albumin. That on the sound side is generally deep amber in color, acid, and is discharged at a slower rate, at least in the early cases. A good example is the following:

A woman, aged 24, had signs of bladder irritation with pus, blood, and tubercle bacilli in the urine. The discharge from the left ureter was very free, faintly acid, and contained flecks of pus. The specific gravity was 1005. That from the right ureter was slow—a few drops at a time, strongly acid, amber in color, and deposited urates on standing. The specific gravity was 1020. The left kidney was normal in size, and presented the following appearances: The greater part of the cortex was quite normal to the naked eye. On section a few gray tubercles were found in the medullary portion skirting pelvis. At lower pole an abscess cavity the size of a small marble and lined with caseous material, was found. The ureter was not thickened.

Thus we have a strong resemblance between the effect of early tubercle and that of a small renal calculus upon the renal secretion.

The following case was more advanced.

The symptoms were similar to those in the one just described. The specimen from the left ureter was discharged in continuous drops, was acid,

watery, with a specific gravity of 1005, and contained pus, albumin, and tubercle bacilli. That from the right ureter had a specific gravity of 1020, was sharply acid and deposited urates on standing. The specimen taken from the bladder just before cystoscopy had a specific gravity of 1010. Supposing that the secretion remains the same during cystoscopy—an assumption by no means always justified—more urine from the left side must have been present to give a specific gravity of 1010 in the mixed specimen. At any rate more urine appeared to be secreted on the affected side. (I have already referred to the difficulty of estimating the quantity discharged when a catheter is in the ureter.) The kidney, which was a little enlarged, showed the following appearances: A few gray tubercles were seen at the upper pole, but not elsewhere. On section the pelvis was found to be ulcerated and studded with tubercles. The calices were hollowed out into abscess cavities lined by caseous material. A large abscess occupied the upper pole, a gray tubercle or two was seen in the cortex, but most of the disease was in the medulla. The ureter was thickened and dilated. In this case the disease was in a more advanced stage than in the one just mentioned.

As disintegration progresses the functional area of the kidney becomes more and more reduced and the urine diminished until it escapes in infrequent drops. Finally, in some cases, the kidney is entirely destroyed, and no urine is secreted. As I have already said, the specific gravity is reduced in almost every case of tubercle of the kidney, and in a large proportion it is 1005 or under. In tuberculous kidney, pain in the loin may be entirely absent so that the diuresis cannot be due to this cause. A deposit of tubercle communicating with the pelvis seems sufficient of itself. As in renal calculus, a balance seems to be established between the output of fluid on the two sides. In early cases, when active diuresis is present, the sound kidney does not secrete its normal quantity of water, whereas later, when the affected kidney is in process of destruction, less and less fluid is secreted by it, and more and more by the sound kidney until finally all the work falls on the latter.

UNILATERAL PYELITIS

Thirty-nine cases of unilateral pyelitis were examined. Of these 33, or a little over 84 per cent, showed a diminished specific gravity on the affected side. One case had a diminished specific gravity on the sound side. In the remaining cases the specific gravity was equal on the two sides. When recovery takes place, the difference in specific gravity on the two sides disappears, as shown in a few cases I had the opportunity of examining. The specific gravity on the affected side may be as low as 1005 or under, as against 1015–1025 on the sound side. In other cases the difference is less. The following is an example of a case of medium severity.

A woman, aged 36, was examined 6 weeks after the onset of her illness. She had frequency of micturition and pain during the act, with occasional small quantities of blood in the urine, X-ray examination was negative, and coliform bacilli were found in the urine. The flow from the right side was more rapid than that from the left. The specimen from the right side was pink-colored, contained pus and blood, and had a specific gravity of 1005. That from the left was free from pus, contained a few red cells due to trauma, and had a specific gravity of 1015.

These cases rarely come to operation but on palpation the affected kidney is frequently enlarged and tender. Once more we have a unilateral diuresis associated in these cases with inflammatory signs in the affected kidney.

TUMORS OF THE KIDNEY

Nine cases of tumor originating in the kidney were examined. In 7 of these, or 77 per cent, the specific gravity was lower on the affected side. One of these had a calculus in the renal pelvis. In addition, there were 4 cases in which the kidney had been involved by extension from a neighboring tumor in the abdomen. In 3 of these there was diminished specific gravity on the affected side. In the remaining case the specific gravity on the affected (left) side was higher than on the sound (right) side, but the right kidney was movable. As a rule in cases of tumor the difference on the two sides is not so great as in stone or tubercle. In some a mild degree of pyelitis is also present on the affected side. The following cases, uncomplicated by pyelitis or stone, are examples.

A woman, aged 60, complained of renal colic and hæmaturia. On the affected side a steady stream of blood-stained fluid was discharged with each efflux. This specimen had a specific gravity of 1005, was alkaline, and contained blood but no pus. On the sound side the urine was clear amber, sharply acid, deposited urates on standing, and had a specific gravity of 1015. The kidney, examined on removal,

was not much enlarged; it showed a projection about the size of a tangerine orange on the outer surface. On section, in addition to the main growth there were areas of a light salmon-pink color, varying in size from that of a pea to that of a walnut, scattered through the kidney. The growth projected into the pelvis and polypoid masses of small size were found in the veins at the hilus, partially blocking some of them. The upper pole and a very small portion of the lower pole were free. The growth proved, on microscopical examination, to be a hypernephroma.

A man, aged 60, with a history of attacks of painless hæmaturia, was examined in an interval. The specimen from the affected (left) side was very scanty, neutral in reaction, had a specific gravity of under 1005, contained much albumin, a few red cells, but no pus and no casts. That from the sound side flowed freely in jets, was acid, and had a specific gravity of 1015. Indigocarmine, injected into the buttock, appeared on the sound side in 18 minutes, but no color could be detected during examination on the affected side. The kidney was very difficult to remove, the pedicle was hard to define, the renal vein being as large as the vena cava, and filled with growth. The latter occupied the lower half of the kidney and scattered areas in the upper half. Death took place, and, postmortem, the vena cava was found filled with growth from the level of the renal vein to the opening in the diaphragm. The growth was not adherent to the vessel walls. It proved to be a typical hypernephroma.

These 2 cases demonstrate that growths may affect the kidney (a) by reducing its secreting area, (b) by projecting into the pelvis and to some extent obstructing the outflow of urine, and (c) by seriously blocking the veins leading from the organ.

The result is, in advanced cases, very greatly reduced renal function. A reference to accounts of experiments on animals is interesting in this connection. Cushny states that Goll found that obstruction of the renal vein causes no increase in the urinary flow, but, on the contrary, arrests the secretion completely. He refers to work by Paneth who made a very careful examination of the effects of partial obstruction of the vein and agreed with his numerous predecessors that the urine is lessened in amount and soon contains albumin and blood if the outflow is retarded for long. He also mentions the experiments of Rowntree, Fitz, and Geraghty, who found that in maintaining partial constriction the urine was sometimes slightly increased: on prolonged slight constriction the urine contains albumin, casts, and blood without any significant change in the amount of fluid, but as the constriction and passive congestion are increased the secretion diminishes, and the excretion of such foreign substances as lactose, ioddies, and dyes is much delayed. Clinical study would seem to confirm these observations in animals, bearing in mind that the amount of kidney substance available for secretion is diminished in the case of tumors.

CONGENITAL CYSTIC KIDNEY

Two cases were examined. In one the specific gravity was low (1005) on both sides, and both specimens contained albumin.

The patient, a woman aged 27 years, suffered from frequent attacks of hæmaturia, and nearly died from loss of blood. A colleague removed the bleeding kidney, but the patient succumbed 10 days later from uræmia. The organ consisted almost entirely of cysts. There was some kidney substance in the central area but this was also much broken up by cystic formation. Microscopical examination showed, in addition to the cysts, chronic interstitial nephritis.

The second case occurred in a woman aged 49 in whom a tumor was accidentally discovered in the left loin. Pyelography showed a much distorted pelvis. The specific gravity of the specimen on the side of the palpable tumor was 1005 as against 1010 on the opposite side. There was more than a trace of albumin on the side of the tumor, and a trace on the opposite side. Operation disclosed a polycystic kidney. The fellow of the opposite side was explored through the peritoneum and found to be similarly affected, though to a less degree. Nothing further was done. In this case the lower specific gravity occurred on the side on which the disease was more advanced.

HYDATID CYST OF KIDNEY

This case was seen during the war.

The patient was an Australian soldier in whose case I was greatly interested, and whom I followed from hospital to hospital till his examination was completed and his kidney removed. He had a tumor in the left side, and gave a history of hæmaturia and the passage of small cysts per *urethram*. The flow on the affected side was quite free and the specimen was watery, opalescent, neutral in reaction, had a specific gravity of under 1005, and contained a trace of albumin, a few leucocytes, ureteral epithelium, an occasional red cell, but no hooklets. That from the sound side was scanty, clear amber, acid in reaction, had a specific gravity of 1015, deposited urates on standing, and was free from albumin. The kidney was removed by Lieut.-Colonel McClure of the Australian Army Medical

Service. The vessels of the pedicle were diminished in size and their walls thickened. The pelvis was somewhat dilated and small hard concretions, which proved to be uric acid calculi, were found here and there in the remains of the kidney. The main part of the latter was replaced by a large mother cyst containing numerous daughter cysts. About a quarter of the kidney remained uninvolved. This portion was fibrotic in the central part, with a small amount of normal-looking kidney at the cortex.

(The thickening of the blood vessels incidentally mentioned here is, of course, a very common occurrence in kidneys that are becoming obsolete from tubercle or other cause, and contributes to the natural "nephrectomy" which is the terminal stage in certain surgical affections of the kidney should the patient survive long enough.)

HYDRONEPHROSIS AND PYONEPHROSIS[1]

Fifteen cases of hydronephrosis and four cases of pyonephrosis were examined, and all showed a diminished specific gravity on the affected side. Cases of pyonephrosis in which thick pus was discharged were not included. In 3 cases hydronephrosis was associated with an accessory renal artery passing to the lower pole. Mr. Hurry Fenwick[2] suggests that this abnormal artery bowstrings the ureter at the site of crossing and perhaps sets up local spasm. Lowered specific gravity on the affected side is a common sign in this condition and may aid in diagnosis. Its absence, however, does not exclude this abnormality.

It is, of course, common knowledge that a thinned-out kidney is likely to be associated with urine of low specific gravity. The following case shows the value of the specific gravity test combined with pyelography.

A man, aged 24, had had three attacks of renal colic on the left side at 5-month intervals. The left kidney could not be felt and X-ray examination excluded stone. There was no history of hæmaturia, and the urine was free from albumin, blood, and pus. The ureteral catheter drew no urine until it had passed the ureteropelvic junction when fluid was discharged in frequent drops. The specimen thus obtained was pale amber in color, acid in reaction, had a specific gravity of 1005, and was free from albumin, blood, and pus. The specimen from the sound side had a specific gravity of 1025. Pyelography showed the typical shadow of hydronephrosis. At operation the kidney was seen to be hollowed out into a multilocular sac with a much-dilated pelvis. There was a small patch of renal tissue at the upper pole. The stricture was situated at the ureteropelvic junction.

It is interesting to note that in this case the condition, which must have been of long standing, only declared itself a year or so before operation, and that no abnormal constituents, such as blood, pus, or albumin, were found in the urine from the affected side.

MOVABLE KIDNEY

Fifteen cases of movable kidney were examined, and in 8 of these the specific gravity was lower on the affected side. The difference was not great as a rule, 1015 on the affected side as against 1020 on the sound side being a rather typical example. I have, however, seen it 1005 on the affected side as against 1015 on the sound side. In this case the patient had a dropped kidney and renal colic on the left side. X-ray excluded calculus. The only other sign was diminished specific gravity on the affected side. Pyelography showed a normal pelvis, and a sigmoid bend in the ureter. Nephropexy cured the patient. In 2 cases the specific gravity was higher on the affected side. These cases may be explained by the kinking of the ureter which is often present. According to the modern theory the slight obstruction thus caused delays the flow and allows of reabsorption of fluid and concentration of the urine. As previously pointed out, however, the obstruction of the ureter may act as a stimulus which produces reflex diuresis on the affected side. The latter result would appear from my observation to be the more frequent. I mentioned this matter to Professor Cushny, and he states in reply: "The higher specific gravity in some cases of movable kidney may, as you suggest, be best explained by the slight kinking of the ureter. You must remember that in these cases of obstruction one sometimes has a paradoxical increase in the urine on the obstructed side which arises, I think, from a reflex from the kidney."

There is another factor to be considered in movable kidney and that is kinking or torsion of the vessels. I am unable to say how far this may alter the character of the secretion.

RENAL HÆMATURIA

Thirty-seven cases classified under the heading of renal hæmaturia were examined. These were due to such diverse conditions as congenital hæmophilia, Henoch's purpura, bilateral nephritis, and the condition known as "essential renal hæmaturia" or "symptomless hæmaturia." In 28 out of the 37 the specific gravity was equal on the two sides. In the condition described as "essential renal hæmaturia" or "symptomless hæmaturia" the specific gravity is, as a rule, equal on the two sides, and the absence of evidence of disease of the kidney, as seen at operation, would rather lead one to expect this. If there is a decided difference between the specific gravity on the two sides one would be inclined to suspect some more tangible cause than that found in these puzzling cases. So far as I have been able to judge, a comparison of the specific gravity on the two sides in cases of renal hæmaturia, without other signs, has not been of great service in diagnosis. I had hoped that such a comparison, when the patient was not bleeding, might have located the side affected. To determine the bleeding side the patient must be examined during an attack of hæmaturia.

RENAL PAIN

Forty-four patients were examined for pain in the renal region of such a nature and of sufficient severity to be dignified by the term "renal colic." Some of these cases were examined under circumstances of difficulty—some in France during the war, and some in outlying districts in Ireland where X-rays were not available. At any rate, a definite diagnosis of the cause of the pain was not made. In 27 out of the 44, or just over 61 per cent, the specific gravity was lower on the side of the pain. In 3 of these there were a few pus cells and a small quantity of albumin in the specimen from the affected side. These were diagnosed as stone, but no confirmation of this is forthcoming, and they have been lost sight of. In no less than 17 cases the urine was free from albumin, pus, and blood. The only evidence of a renal origin was pain, with diminished specific gravity on the affected side. A few of these were actually operated on for suspected calculus with a negative result. One case at least suggests that the pain was referred to the sound kidney. The specific gravity on the side of pain was 1025, and albumin was absent. On the apparently sound side the specific gravity was 1015 and albumin was present.

A few cases had pain on both sides, and in one of these a diminished specific gravity and a small quantity of albumin were present on one side. I have no doubt that renal pain, from whatever cause, is capable of producing a reflex diuresis on the affected side. As our methods of diagnosis become more perfect, cases of renal pain of unknown origin will become much fewer, but I imagine that painful spasm of the ureter, apart from any demonstrable lesion, is a possible explanation in some cases.

WOUNDS OF THE KIDNEY

Nineteen cases of gunshot wounds of the kidney were examined. In 9 of these the specific gravity was lower on the affected side. Infarcts were commonly present in these cases; in some there was evidence of infection as indicated by the presence of pus and micro-organisms in the urine, but in others the urine from both ureters was normal. In one case the specific gravity was 1005 on the sound side as against 1015 on the injured side. The functional capacity of the uninjured kidney, as shown by the output of phenolsulphonephthalein and urea, was diminished. In the remaining 9 cases the specific gravity was equal on the two sides. All the cases were examined within 3 months of the injury. Having already discussed this class of case at some length in the *British Journal of Surgery*, 1917, v, No. 18, and at the Conférence Interalliée held in Paris in November, 1918, it is unnecessary for me to do more than refer those interested to my previous writings.

From the foregoing detailed cases and others unclassified, I am satisfied that when dealing with unilateral lesions, one of the most important factors in determining which kidney is the seat of disease, is the marked reduction in the specific gravity of the urine from the affected side.

REGENERATION OF RESECTED URINARY BLADDERS IN RABBITS[1]

By HELIODOR SCHILLER, M.D., F.A.C.S., Chicago

REGENERATION generally is defined as the reiterated formation of a lost part or parts of a morphological unit, or the new formation of lost cells from cells of the surrounding tissue. It means the power to replace a lost part in such a manner that the new-formed part corresponds with the lost one in form, structure, and size. This faculty is innate in each cell of the plant and animal kingdom; in the latter both in the protozoa and metazoa.

There are two forms of regeneration: the physiological one, for instance, the constant reformation of epithelial cells, hair, blood cells, etc.; and reparative regeneration, which we see as a sequel to loss of tissue substance following trauma. Closely related to regeneration is the process of compensatory hypertrophy, as observed in the glandular organs of the vertebrata, for instance the kidneys, ovaries, etc.

A difficult question is the histogenesis of regeneration, the question of the origin of the cell material for the formation of the regenerated part. Bord's law, *omnis cellula e cellula eiusdem generis*, seems fairly established for the higher vertebrata, but in the lower metazoa conditions are quite different and varied. Not even the strict dividing lines between ectoderm, mesoderm, and entoderm are respected, and regeneration of ectodermal organs from the entoderm and vice versa are repeatedly observed.

Those organs in animals which constantly and physiologically are replaced have also the highest power to regenerate after traumatism, as for instance the epidermis, mucous membranes, the blood. With the increased phyletic development of the animal species the regenerative power diminishes; the higher the state of development of the metazoan organism, the less its power for regeneration. It decreases with increasing age and, in the mammalia, is lowest after maturity has been reached; regeneration decreases parallel with the phylogenetic and ontogenetic development of the animals. The power to regenerate whole members, limbs, etc., has been lost in the more highly developed animals; in man it is confined to regeneration of tissues only.

The ultimate cause of regeneration is to be found in the bioplastic energy inert in each cell. This bioplastic energy becomes kinetic through the loss of tissue and the loss of resistance, which the lost tissue exerted upon the potential bioplastic energy of the surrounding normal tissues. But not only the loss of tissue with its loss of restraint, but also the mechanical stimulus, the trauma, is a formative factor. The location of the injury, the function of the injured organ, the age of the animal and its condition, light, chemical agencies and lastly, the influence of the nervous system are to be counted; however, investigation by Loeb has shown that the rôle of the latter is not at all important; transverse section of the cord does not necessarily hinder regeneration.

Concerning regeneration of the bladder as a whole in the mammalia little is known. However, a great literature exists on the question of regeneration of smooth muscle in the human. Busachi (1) found regenerative processes in smooth muscle fibers, numerous instances on the seventh day following an injury to the prostate, intestines, and uterus; Baumgarten notices instances in the smooth muscle layer of the bronchi; Stilling and Pfitzner (2) found that defects of smooth muscle are first replaced by connective tissue, which in turn is gradually replaced by smooth muscle fibers. In general, it is believed that in the human there is little tendency for regeneration of smooth muscle. Mall (3), in his extensive investigation of the healing of intestinal wounds, found the only sign of regeneration of smooth muscle fibers in the muscularis mucosæ, while the cut ends of the muscle layer did not show any signs of regeneration after 6 weeks.

Still there exists a most active regeneration of smooth muscle fibers in the reformation of blood vessels and regeneration of smooth

[1] From the Laboratory of Medical Research of the Michael Reese Hospital.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 1. Normal, medium-filled bladder of a 6-month old rabbit.
Fig. 2. The new bladder 6 months after extirpation.
Fig. 3. Nine months after extirpation.
Fig. 4. One year after extirpation.
Fig. 5. One year, six months after extirpation.

muscle fibers certainly cannot be denied in the human.

My experiments were performed on rabbits under 6 months. The extirpation of the bladder was done as extensively as possible, the bladder being extirpated clear down to the ureteral orifices and anteriorly, close to the urethra; the cavity left was hardly capable of holding ½ cubic centimeter of fluid. The rabbits stood the operation very well; only two out of nine animals were lost through infection. After the elapse of 3, 6, 9, 12, and 18 months the animals were reoperated upon, and the new-formed bladder removed. In one case the new-formed bladder was extirpated as described in the previous operation and again after 3 months a good size, reformed bladder was found. The new-formed bladder did not have the smooth external surface of the normal bladder; there were numerous adhesions to the adjacent tissue, but the bladder, corresponding to the lapse of time since the operation, had attained a good size and the last one after 18 months, when distended by fluid, was about one-third smaller than a normal bladder. No changes in the ureters or pelvis of the kidneys could be found.

Objections could be raised against the use of the word regeneration of the bladder. It could be contended that we deal here with plain hyperplastic conditions, analogous to the immense hyperplastic and hypertrophic conditions met in bladders of tabetics or in bladders with strictures below the bladder. I will give now the histological description of the specimens which Dr. O. T. Schultz, director of the Nelson Morris Institute, kindly furnished me and his conclusions.

21P371 (3 months after operation). The bladder wall has three distinct layers. The inner is made up of large polyhedral cells, which form a layer from 6 to 15 cells thick. These cells are so closely placed that cell boundaries cannot be distinguished. Their nuclei are large, vesicular, and oval or round. In the deepest layer of cells the nuclei are slender and long and lie with their long axes parallel to the surface. On the free surface is a thin layer two or three cells thick, in which the nuclei are shrunken and condensed. This thin layer of cells apparently represents the epithelial portion of the mucosa. The denser, more prominent membrane composed of polyhedral cells is a regenerated connective-tissue membrane which, in those portions of the bladder where the epithelial layer is very thin, forms the chief constituent of the mucosa. In other portions of the bladder the epithelial layer is thick, distinct, and composed of large cells. Where such a well-developed epithelial layer is present the underlying connective-tissue membrane is thin, dense, and its cells are more elongated and mature. The section shows the condition last described comes from the lowermost portion of the bladder, and is, perhaps, some of the original normal bladder. The mucosa in places is thrown into broad, low folds. Beneath this inner layer is a second or middle layer of loose connective tissue corresponding in structure to submucosa. This layer is from two to three times as thick as the inner layer. Just beneath the mucosa it contains a few groups of lymphocytes. In a few of the broader folds of the mucosa the submucosa extends upward into the folds; elsewhere it takes an even course. The outer half of the submucosa is traversed by numerous, very slender bundles of smooth muscle, most of which are cut longitudinally or obliquely. This group of muscle

bundles corresponds to the submucous muscular coat of Ellis. The outer layer is composed of smooth muscle and varies somewhat in thickness. In some places it has about the same thickness as the mucosa; in other places it is as thick as the submucosa. The muscle bundles which make up the outer layer vary in size and run in various directions. Often the bundles are slender and are continuous with those of the deeper portion of the submucosa. The muscle coat is covered by a thin layer of connective tissue. At one point this layer is increased and contains a group of foreign body giant cells, which have probably been formed about suture material, although none of the latter is now present in the tissue.

21P1036 (6 months after operation). This bladder also has three distinct layers. One-half the mucosa is thin and has the same character as in the section described above. In the thicker portion of the wall the mucosa is markedly folded and has two distinct layers. The superficial one is two to four cells thick and is composed of large polyhedral cells with prominent cell boundaries; the cytoplasma of these cells, which are evidently epithelial in type, is coarsely vacuolated. Beneath this layer is a denser one, which has the general characteristics of the mucosa of the section first described. The submucosa throughout is thin; it is most prominent in the folds of the mucosa. The muscular coat forms a distinct and complete layer, the inner half of which is composed of slender bundles, the outer half of larger bundles. The muscle coat is of approximately equal thickness throughout. The greater thickness of one part of the wall is due to folding of the mucosa.

21P1037 (one year after operation). The mucosa is a thin, dense layer, in which the nuclei are more spindle-shaped than in the corresponding layer in the other specimens; in consequence, this layer has the appearance of a fibrous membrane. On its free surface there are, in places, a few cells of epithelial type; at one point these cells form a definite layer of considerable surface extent. The mucosa is thrown into broad, low folds. The submucosa is thicker than either the mucous or muscular layers. It is composed of loose, areolar tissue, in whose outer half are slender muscle bundles. The muscular coat is composed of larger bundles, which run in various directions.

22P58 (one and one-half years after operation). The mucosa is covered by a complete and distinct layer of transitional epithelium from four to eight cells thick. This rests upon a very thin, fibrous membrane noted in the other specimens. The mucosa forms short and broad or long and slender folds. Beneath the mucosa is a submucosa whose thickness forms about half the thickness of the bladder wall. Its tissue is rather dense and is not so loosely arranged as in the other specimens. The muscular coat is less well developed than in the other specimens. In some places it is thinner than the submucosa, and in other places thicker. Its muscle bundles are rather slender, and do not extend up into the deeper layer of the submucosa as in the other sections.

In all the new-formed bladders the normal layers are present and bear the usual relation to each other. It is conceivable that such a condition might be brought about by mere mechanical distention of the portion of the bladder left behind, associated with hypertrophy of the original elements. The most striking feature in the reformation of the bladder is the thick subepithelial layer of the mucosa which is formed in the earlier stages of the process. The marked development of this layer suggests that in the beginning it takes an important part in re-establishing both the size and the form of the bladder in the earlier stages, and its later transformation into a thinner layer of more mature tissue corresponding to that of the normal rabbit bladder, would indicate that the formation of this layer, at least, is a regenerative process and is not due simply to distention of the bladder remnant.

A close study of these histological findings gives definite proof that we are justified in speaking of a true regenerative process in these reformed bladders; the muscle fibers in the new-formed wall are described as slender, so are the muscle bundles. If we had to deal with hypertrophic and hyperplastic conditions, we would expect just the contrary. Hyperplasia no doubt takes place shortly following the resection, but soon regeneration sets in and plays an important part.

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DIVERTICULA OF THE BLADDER IN CHILDREN[1]

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UNTIL comparatively recent years, diverticulum of the bladder in adults was considered very rare, only half a dozen cases having been reported in American literature up to the year 1906. Since then, however, many articles have appeared with numerous case reports, so that, at the present time, the condition cannot be considered very unusual. The increase in cases during the past decade is, no doubt, due to the almost routine application of the cystoscope and X-ray in the study of the diseases of the urinary organs. At the present day, we are in the same position concerning our knowledge of diverticulum of the bladder in children as we were for adults in 1906. After carefully searching the American literature only three case reports in patients under 10 years of age were found. This is rather surprising, because at present most writers favor the congenital theory of the origin of these pouches. In fact, some authors point to the extreme rarity of this condition in childhood, in support of the acquired theory of formation. Undoubtedly vesical diverticula are more frequently present in children than would be inferred, many diverticula being overlooked because the proper methods of examination have not been carried out. It is only in recent years that cystoscopy in children has been used, and we can, no doubt, look forward to an increase in the number of case reports as soon as this procedure is more popular.

INCIDENCE

It is by no means possible to state in exact figures the incidence of vesical diverticulum in the young, for the cases reported by one author are quoted by others without mentioning explicitly the source of information. As a result, some of the series overlap, making the number of cases appear greater than it really is. That the condition is very infrequent may be attested by the following. None of the standard textbooks of pediatrics even mention this anomaly. Hinman (8) collected a series of 209 cases of diverticula, from 1899 to 1919, in which but one occurred in a patient under 10 years of age. Fischer (7) collected 48 cases from the American and German literature, up to 1910, in which 6 were in children below 14 years of age (clinical and autopsy findings). Two children (8 and 12 years) were cured by operation. The youngest was in a child of 20 months. These cases were probably the ones described by Englisch (6). Single cases are reported by Wallfield (21), McNeil (16) and Young (23), the latter's being included in Hinman's series. A search of the German literature makes no reference at all to this condition in children since the very comprehensive paper compiled by Englisch (6) in 1903. In this article, the author collected one hundred and seventy-one vesical diverticula in which calculi were found associated (operative and autopsy statistics). Twenty-two occurred in children below 10 years of age, the youngest being an infant 8 days old. These cases are cited by Englisch, in support of the congenital theory of their formation. Durrieux (5), in an excellent monograph which appeared in 1901, reports in detail 195 diverticula of the bladder, 13 of which occurred in children below the age of 10 years. In 8 of the 13, calculi were found associated. A diverticulum was found in the fœtus in two instances. In no case was the diagnosis made by cystoscopy or cystography. The majority were discovered on the operating table or at postmortem. Some of the cases described by Durrieux were also cited by Englisch. Analyzing most of the published articles, which have appeared during the past two decades, approximately 600 cases of diverticulum of the bladder have been reported; between 25 and 30 of these occurred in children below the age of 10 years.

ETIOLOGY

Diverticula have been classified as true and false, the former comprising those in which all the coats of the bladder are present in the

[1] From the Surgical Service of Dr. Beer, Mt. Sinai Hospital; read before the American Urological Association, Atlantic City, May 27, 1922.

sac; whereas the false are formed by mucous membrane alone. Two types of true diverticula, the congenital and acquired, have been described, and at the present day, despite much careful investigation, a considerable difference of opinion still prevails, concerning the underlying etiological factor. No attempt will be made here to discuss this point in detail, for it has been ably presented in late years by other writers. Suffice it to say that there are supporters of each theory. Cabot (3), Rathbun (18), Israel (12), and Hofmokl (10) are of the opinion that the great majority of diverticula are congenital in origin; others, Howard (11), Lerche (14), Wagner (20), Hinman (8), and Thomas (19) consider them all acquired. Then there is a group of observers (Englisch, 6; Judd, 13; Fischer, 7, etc.) who are of the opinion that both factors (congenital and acquired) are responsible for their development. Until recently, Lower (15), who has had considerable experience in the treatment of this condition, stated that these pouches are practically always acquired. However, as a result of Watson's recent publication (22), Lower now inclines more to the belief that "there is a congenital predisposition to diverticula." The fact that these pouches had been found in the fœtus was used as an argument in favor of their congenital origin. Watson, in a study of the development of the lower genito-urinary tract, found it possible to observe the vesical cavity in its progressive development, from early fœtal life until birth. "In the course of these studies, certain pictures of the bladder cavity have been of striking significance, and it appears that certain factors are present, which may be of importance in determining the formation of diverticula." Watson believes that, whereas there is a congenital predisposition to diverticula, "their clinical recognition during adult life is hastened, and their dimensions greatly increased by any of the factors that would bring about increased vesical distention or increased activity of the bladder musculature." One further favors such an opinion after carefully studying many of the case reports in adults, when it will be found that the duration of urinary symptoms often dates back 10 to 15 years, sometimes even to early childhood.

The following report is based upon three cases of diverticulum of the bladder, observed during the past 6 years; two occurring in young children, and one in an infant of 9 months. Before describing them in detail, it will be well to discuss, in a general way, certain features to show wherein this condition in the child differs from that in the adult. Attention has been called to the fact that in congenital diverticulum other anomalies in the genito-urinary tract, such as double renal pelvis, double ureter, spina bifida, etc., are frequently present. In one of the three cases there was a hypospadias; the others showed no anomalies.

Number of diverticula. Two symmetrically placed pouches were found in the infant; the other two patients had single sacs. The size of the pouches varied from that of a small plum to that of an orange.

Location. As in the adult, the site of predilection was in the neighborhood of the ureteral orifices. The position of the sac is of more importance than the size, for small diverticula in close proximity to the ureter, by compromising its lumen, do far more damage than large ones which are so situated as not to involve the ureters. In these three cases, the diverticulum was found so closely adherent to the ureter as to occlude its lumen, requiring division and reimplantation into the bladder.

Sex. All three cases occurred in males; there is no reported case of a diverticulum in a female child. In the adult, but 10 in 225 cases were in females.

Age. One patient was 9½ years old at time of operation; the second, 3 years, and the third, 9 months.

Urine. A marked pyuria was present in all three instances. It is a curious fact that we rarely see these cases early in their course when the urine is clear. It is not until urinary infection supervenes, bringing on an added train of symptoms, generally acute in character, that medical advice is sought.

Position of ureteral orifice in relation to sac. In two of the cases, the diverticulum lay anterior to the ureter. In the third, the right ureter opened into the diverticulum, the orifice of which had a contractile sphincteric

action. A real sphincteric action of the diverticular opening is very rare, and has been described but a few times (Buerger, 2; Pagenstecher, 17; Blum, 1). Twelve cases have been reported in the literature, in which the ureter opened into the sac.

Residual urine. It is of interest to note all of the cases showed a residual urine, varying in amount. The infant had complete retention; catheterization twice daily yielded 12 to 14 ounces of urine each time. In this instance, the retention can be explained by the pressure of the two large sacs causing obstruction at the bladder neck. After excision of the pouches spontaneous urination occurred. The other two patients had smaller amounts of residual urine. In Case 3, there was never more than 1 ounce of residual urine, yet the bladder could be palpated, reaching as high as the umbilicus. At operation, this was found to be due to a marked hypertrophy of the vesical musculature.

DIAGNOSIS

The diagnosis of this condition in children should not entail more difficulties than in the adult. True, we are denied the information which can be obtained by a recital of subjective symptoms, but this is not so important, for at best, the evidence so obtained is uncertain. The symptomatology of diverticulum, even in the adult, is by no means sufficiently clear to class it as a clinical entity, and the same applies to this condition in childhood. It is of interest to note that, in contradistinction to the history usually obtained in adults, the duration of symptoms was very brief, and the onset sudden, in all three instances. In two cases, the initial symptom was an acute retention, in the other, a hæmaturia which first occurred 6 days prior to admission. Pyuria was present in a marked degree in all. Undoubtedly, these diverticula were present since birth, but it was not until urinary infection supervened that the condition became acute. Two of our three patients had been treated for pyelitis, pus having been found in the urine. It might be well at this point to digress for a moment on the subject of pyuria in childhood. The presence of pus in the urine seems to be a sufficient excuse for the diagnosis of pyelitis. We have examined a number of children within the past few years, treated for long periods of time for pyelitis, in whom serious diseases of the lower urinary tract were present, the kidney infection being a secondary involvement. One should be extremely careful, especially in male children, before attributing a pyuria to a pyelitis. In none of the cases had a cystoscopic or X-ray examination been made, prior to admission to the hospital. This is not surprising, for these diagnostic procedures have not as yet been accorded their due recognition in the study of urological diseases in the young. Having determined the presence of pus in the urine, the next step should be to make a careful abdominal examination, inspecting and palpating carefully the suprapubic region. The importance of this cannot be over-emphasized. In our 3 patients, there were always varying amounts of residual urine, with consequent distention of the bladder. A protuberance in the suprapubic region was distinctly visible, and the bladder could be palpated, reaching to the umbilicus. Such a distended bladder should immediately focus our attention on the two conditions which cause residual urine in childhood. These are the chronic retentions of urine due either to a mechanical obstruction, or to a neurological condition, or a diverticulum of the bladder. Should the distention be asymmetrical, it would lead one to suspect the presence of a diverticulum. Catheterization should follow, note being made of any obstruction in the urethra and of the amount of residual urine. A definite diagnosis, however, cannot be made, without resorting to the use of the cystoscope or cystogram, or both combined. Of the two, the cystogram is of more importance in children, and will give more useful information than cystoscopy. Cystoscopy is at times difficult in the young, especially in the presence of a marked pyuria, when it may be impossible to cleanse the bladder sufficiently to obtain a clear picture. Although cystoscopy shows us the orifice of the pouch, it gives no idea of its size or shape. It is even possible, during the course of a careful examination, to overlook a diverticulum with a small opening. Cystography is such a simple procedure that it can be per-

formed, even in very young children, without the slightest difficulty and requires no anæsthetic. In our youngest patient, cystoscopy could not be carried out because it was impossible to obtain a sufficiently clear medium to see through, as the purulent urine from the sac constantly clouded the field of vision. The roentgenograms should be taken in different positions, otherwise a small sac may be overlooked or the shadow of the diverticulum may be obscured by that of the bladder itself. In young children, it is possible to obtain excellent pictures in the lateral, as well as anteroposterior positions. Contrast cystography, as recommended by Hinman (9), may give added information. This is accomplished by taking a plain cystogram after which the solution is drained off and air injected into the bladder and another plate taken. The air-filled bladder stands out in contrast to the sacs which still contain the opaque solution. If cystoscopy and ureteral catheterization are feasible, it may be of value to introduce a leaded catheter into the ureter, to outline its relation to the sac. The passage of an opaque catheter into the sac does not give as valuable information as the cystogram.

PROGNOSIS

In general, it may be stated, that the prognosis is favorable, provided there has not been irreparable damage of kidney tissue. It is surprising to note how well children stand the major operative procedures necessary to effect a cure. Before undertaking operation, it is of extreme importance that kidney function should be carefully studied, and attempts made by hygienic and dietary measures, to put these little patients in the best of condition. Attention may here be called to the fact that in Cases 2 and 3 successful results were obtained although the function was very low. It may be necessary when there is a large residual urine, to drain the bladder with an indwelling catheter, and combat infection by bladder irrigations. By carefully prepared pre-operative treatment, the mortality should be very low.

TREATMENT

Conservative, non-operative measures are of no avail. Constant daily vesical irrigations are useless, as are any other non-surgical methods. Rathbun (18) has suggested a preliminary suprapubic drainage which may occasionally be of value in tiding over a very sick child, until the local and renal condition have improved to a degree warranting more radical procedures. The best results are obtained by radical extirpation of the sac, by an extraperitoneal exposure of the bladder. Good results have also been obtained in the adult by the intravesical excision, advocated by Young (23); however, the former operation should be the one of choice. The technique of operation is similar to that employed in the adult and has been fully described in various publications. A few words as to the proper treatment of the ureter. In a large number of cases, the diverticulum will be found in close proximity to the ureter. The difficulty in identifying the ureter and separating it from the sac when dense adhesions are present, is eliminated by exposing the ureter above the diverticulum, making a small slit in it and passing a bougie down through it into the bladder. This method also gives us immediate information as to its patency. When the ureter is occluded, there is but one course to pursue, namely, its division and reimplantation into another part of the bladder. When the ureter opens into the diverticulum, or adjoins it, two methods of treatment are applicable. Young (24), a number of years ago, suggested a technique which leaves a flap of bladder wall around the ureteral meatus after completely excising the rest of the sac. The flap containing the orifice is then sutured into the bladder wall. Judd (13), recommends that in those cases "in which the ureteral opening is found marginal, the adjoining mucous membrane should be turned into the bladder closure," the meatus being preserved. It is advisable, whenever possible, to employ a technique which does not interfere with the integrity of the ureteral mechanism. In our three cases, the ureter on the side of the sac was found occluded, requiring division and reimplantation into the bladder. Some years ago, Cabot (4) suggested ureteral drainage for the dilated ureters, in which division or the Young flap operation had been done. He introduced a soft rubber catheter into the ureter, reaching up

Fig. 1, Case 1. Cystogram showing distinctly large diverticulum.

Fig. 2. Cystogram of Case 1 showing dilated ureter.

almost to the renal pelvis, bringing its lower end out through the suprapubic wound. In the cases in which this technique was employed, the postoperative course was unusually smooth.

The following three cases on which this paper is based, are of such unusual interest as to warrant their description in detail.

Case 1. M. B., male, age 9½ years, admitted to Mt. Sinai Hospital, March 15, 1915. Except for diphtheria, past history was negative. Six days before admission, he noticed terminal hæmaturia, accompanied by pain on urination. After micturition he felt that he had not finished, and could always void a little more. There has been pain in the hypogastric region.

Examination showed a penile hypospadias. The voided urine was turbid, contained much pus, and a heavy trace of albumin. There was slight lumbar tenderness. The bladder was distended, the neurological findings, negative. Phthalein test showed 45 per cent; no tubercle bacilli found in urine. Cystoscopy showed the opening of a diverticulum in the left bladder wall, near the site of the left ureteral orifice. The orifice appeared to open near the mesial posterior edge of the diverticulum. Indigocarmine was seen pouring out in good concentration. The right ureteral orifice was patulous. Good indigo concentration in 14 minutes. A cystogram with argyrol revealed distinctly a large diverticulum, also a dilated left ureter (Figs. 1 and 2).

Operation, March 27, 1915 (Dr. Beer). Extraperitoneal extirpation of diverticulum of bladder and lower end of left ureter, with implantation of ureter in posterior wall; suprapubic drainage. Through a median suprapubic incision, the bladder was separated from the perivesical tissues and the very thin peritoneum pushed off with difficulty. In so doing, the peritoneum was opened, permitting of digital exploration of the peritoneal cavity. After repairing a tear into peritoneum, the bladder was filled with fluid, and the diverticulum was located in between the trigone and rectum, firmly wedged in the pelvis. By drawing the bladder out of the abdomen after it was freed, it was possible to deliver the diverticulum from its bed and ligate its neck. The diverticulum lay in such a position, between the course of the two ureters, that whenever it was full, it of necessity compressed these. The left ureter was markedly distended, and was cut across, about an inch from the bladder, where it became intimately adherent to the inflamed wall of the diverticulum. The ligated neck of the sac and the lower end of the ureter were buried in the bladder wall with several layers of sutures. Then the ureter was implanted in the left posterior wall of the bladder. The bladder was closed following the Kader technique and suprapubic and perivesical drainage applied. Two weeks later the drainage tube was removed and the Kader neostomy functionated well, patient remaining dry. Convalescence was uneventful. Cystoscopy 6 weeks after operation showed ureteral neostomy functionating well. Patient last examined in March, 1922, 7 years after operation. He is perfectly well and has no urinary symp-

Fig. 3. Anteroposterior view of Case 2 showing two large diverticula.

toms. The urine is clear, and shows no abnormal elements. The patient refuses cystoscopic examination, so that it cannot be determined whether or not the neostomy is functionating.

Summary. A boy of 9½ years, with a urinary history of 1 week's duration and pus in the urine. Cystoscopy and cystogram revealed a diverticulum of the bladder, with a dilated left ureter. Operation disclosed a diverticulum, behind the trigone, pressing on both ureters and attached to the left ureter, which had to be sacrificed in its lower 1 inch on resecting the sac. Normal convalescence — patient well 7 years later. No evidences of any obstruction in the lower urinary tract were found.

Case 2. H. F., a male infant, 9 months of age, was admitted to Lebanon Hospital, service of Dr. Haas, February 7, 1921. I am indebted to Dr. Haas, who asked me to see this most unusual case, a few days after admission. The infant was a full term baby, normal delivery and normally developed. He was well until January 9, 1921 (4 weeks before admission), when symptoms developed which were attributed to indigestion. There were frequent loose, green stools, abdominal cramps and fever. Castor oil was administered, but the illness continued unchanged for the next few days, when the mother noticed that the baby's abdomen was becoming progressively more distended. At about this time, it was also noticed that very little urine was voided, and then urination stopped for one day. No specific significance was attached to this. Previous to this, no urinary symptoms had been noticed. The temperature rose to 104°, and a diagnosis of intussusception was made, and immediate operation advised. A surgeon called in consultation, concurred in this diagnosis, which was made on the history of diarrhœa, abdominal distention, and a large mass which could be palpated, abdominally and per rectum. At operation, as well as we could determine, no intussusception was found, but instead an enormously distended bladder reaching above the umbilicus was discovered. The abdomen was immediately closed, a catheter introduced and 32 ounces of purulent urine withdrawn. For 3 days following operation, there was complete retention, requiring daily catheterization. Then spontaneous voiding in small amounts ensued, mainly dribbling in character. Catheterization had to be carried out daily on account of the large residual (12 to 18 ounces). For the past 3 weeks the temperature fluctuated from normal to 104°. The infant became progressively worse, lost considerable weight, became very anæmic, took little nourishment, and had a number of convulsions. The baby was admitted to the hospital February 7, 1921, in a most desperate condition. The admission notes read as follows:

Examination. The infant is comatose, makes continuous sucking movements with its tongue, which is thick, dry and coated. There are convulsions of the upper and lower extremities from time to time. The abdomen is distended, and the bladder can be palpated, reaching to the umbilicus. The temperature ranges between 102° and 103°. It can, therefore, be seen from this description that the baby was in a most desperate plight. Daily catheterization revealed a residual, varying between 10 and 18 ounces of turbid urine, acid in reaction, specific gravity 1023, loaded with pus, and containing a heavy trace of albumin. Cultures of urine showed colon bacilli and staphylococcus aureus. The phthalein test was less than 10 per cent for 2 hours. Blood urea showed 45 milligrams per 100 cubic centimeter, non-protein, nitrogen 98.4. Indigocarmine did not appear in the urine until 10 hours after injection. X-ray of urinary tract was negative. In order to improve the baby's condition, it was considered advisable to resort to catheterization twice daily, followed by bladder irrigations; water was forced, being given by mouth, rectum, and hypodermoclysis. Under these measures, there was some improvement noted in the general condition although the functional tests showed no change. Cystoscopy could not be performed on account of the impossibility of obtaining a sufficiently clear medium, despite prolonged irrigations. A cystogram was then taken, injecting 12 ounces of 20 per cent sodium bromide. The roentgenograms taken in the lateral and anteroposterior position showed distinctly two large diverticula, one on each side of the bladder (Figs. 3 and 4).

A definite diagnosis having been established, the question of operation arose, but it was considered advisable to wait until the general condition and renal function showed more improvement. This was accomplished by April 10, more than 2 months after admission to the hospital.

Operation, April 10, 1921, Dr. Howard. Ether anesthesia. Through a median suprapubic incision, the

bladder was exposed, found markedly enlarged, thinned out and flaccid, reaching as high as the umbilicus. After separating the bladder from the peritoneum, the viscus was opened, and two large diverticula were found, one on each side of the bladder. The orifices of the diverticula admitted the index finger, and each sac was found intimately adherent to the bladder and surrounding tissues. By introducing a finger in the sac, it was found that its mobilization could be more readily carried out. The sacs, both the size of oranges, were in this manner freed extraperitoneally down to their entrance into the bladder. The right ureter was seen, normal in size, running along the posterior wall of the diverticulum, from which it was readily separated. The right sac was then excised, and the opening in the bladder wall closed with two layers of sutures. The left ureter, considerably dilated, was found firmly adherent to the posterior wall of the sac, from which it could not be separated. About an inch above the meatus, the ureter was found to be strictured so that the smallest probe could not be introduced, either upward through the orifice, or downward through a small incision made in the ureteral wall. At this time it was realized that the kidney on this side was most likely very seriously damaged, but it was considered advisable to adopt conservative methods. The sac, with about an inch of ureter, was excised, and the bladder opening closed with two layers of sutures. The ureter was then reimplanted into the left posterior wall, allowing a half inch or so to protrude into the bladder. The internal urethral orifice was explored with the index finger; no contraction or evidences of obstruction were found. The ring was smooth and soft, and the tip of the little finger could be easily introduced through it. (There was at no time any obstruction to the passage of catheters, or bougies through the urethra.) The bladder was closed in layer sutures, allowing space for tube drainage. The abdominal wall was sutured, drains placed in prevesical space. Time of operation, 55 minutes.

Pathological report. Sacs have a smooth glistening appearance and are thin-walled. Microscopically, specimen is covered with a narrow zone of epithelial tissue, which ranges from flat to cuboidal cells. Within this lining is loose connective tissue with numerous blood vessels and sparsely infiltrated with small round cells. Surrounding this layer is a dense muscular layer.

Result. Following operation, the baby was considerably shocked for the first 24 hours; from then on, improvement was steady. Drainage through the suprapubic tube was profuse, and the urine became considerably clearer. From week to week, the general condition improved; the infant gained weight, temperature dropped to normal. Within a month, the phthalein test was 45 per cent for 2 hours. The suprapubic wound closed, except for a tiny opening at its lower end through which purulent urine constantly escaped. Despite all treatment, it was found impossible to close this sinus. On examination one day, it was found that by pressure over the left kidney, the flow through this opening was considerably increased and it was then realized that the profuse purulent drainage was probably due to a pyonephrosis with a pyo-ureter. Under these circumstances, there was little likelihood of closing the sinus, unless the kidney was extirpated. This state of affairs persisted for almost 7 months, during which time the baby improved remarkably. The local condition remaining the same, the parents finally consented to another operation which was performed November 29, 1921 (Dr. Hyman). A suprapubic incision was first made, and the sinus was traced from its lower end. It was found to communicate with the enormously dilated left ureter. This was the ureter which had been reimplanted, and had evidentally become partially detached at the site of the neostomy. The sinus was therefore extravesical. The baby was then turned on his side, and a left lumbar incision made, and after considerable difficulty a complete nephro-ureterectomy was performed, removing the kidney and ureter, down to its vesical end in one piece. The kidney was completely destroyed, being merely a pus sac, and the ureter was so dilated as to be at first mistaken for large gut. The lumbar wound was closed in layers, and a tube introduced into the bladder for drainage. The child quickly recovered from the shock following this procedure, which lasted almost an hour. Despite an otitis media, which later developed, the baby was discharged from the hospital 6 weeks after this operation with both wounds closed, and voiding a clear, normal urine. On last examination, a few weeks ago, the baby was found to be in excellent condition; he has gained considerable weight, seems to have no difficulty in voiding, and looks the picture of health.

Fig. 4. Lateral view of Case 2, showing diverticula.

Fig. 5. Case 3. Cystogram shows a small diverticulum on the right side of bladder.

Summary. An infant 9 months of age was seized rather suddenly with acute abdominal symptoms. Operation for intussusception revealed instead a distended bladder. Then it was realized for the first time that the trouble was due to a vesical condition. Cystography revealed bilateral diverticula which were excised and the left ureter which was compromised, was divided and reimplanted. Subsequent failure of the suprapubic wound to heal, due to a pyo-ureter on the left side; nephro-ureterectomy, complete recovery. No evidences were found of any obstruction to urination.

This is probably the youngest case on record in which a diverticulum was successfully removed and the patient recovered.

Case 3. S. L., male, age 3 years, admitted to Mt. Sinai Hospital, service of Dr. Beer, February 11, 1922. Normal delivery—whooping cough, otherwise well, until 6 months ago, when child had retention of urine, relieved spontaneously. Since then, urine has been cloudy, and he has had attacks of painful urination. He has pain in the back and in both loins occasionally. He sweats profusely, but he has no chills.

Examination showed an anæmic, undernourished child. The abdomen, below the umbilicus is protuberant, and the bladder can be distinctly palpated. Lower pole right kidney is palpated. The urine is turbid, contains a trace of albumin, and is full of pus. Catheterization is accomplished without obstruction. Only 1 ounce residual. The enlarged bladder was more the result of a markedly hypertrophied bladder wall than an actual dilatation. X-ray of urinary tract was negative. Phthalein test showed

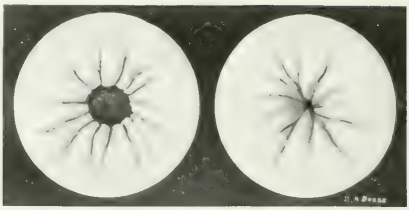

Fig. 6. Cystoscopic picture. Case 3, diverticulum open and closed, showing sphincteric action of orifice.

10 per cent for 2 hours. Blood chemistry shows increase of non-protein nitrogen (49.9). Cystoscopy (ether anæsthesia) shows bladder slightly inflamed, left meatus normal, right meatus cannot be seen. In this region there is an opening of a diverticulum, the orifice of which has a distinct sphincteric, contractile action. When closed it is difficult to make out its location; when open, it discharges a turbid fluid. At the time, it was surmised that the right ureter opened into this diverticulum. No indigocarmine came from either side in 15 minutes' observation (appeared in voided specimens some time later: late indigocarmine excretion). Culture of urine showed staphylococcus aureus. Cystogram showed a small diverticulum on the right side of bladder (Fig. 5).

The condition of the child while in the hospital became progressively worse. High temperature developed which was attributed to a right pyelonephritis.

Operation was decided upon, and was performed February 25, 1922 (Dr. Beer). Suprapubic incision. Deep down in the pelvis on the right side and firmly adherent to surrounding parts and ureter, is a small diverticulum. Marked peridiverticulitis. The ureter which was considerably dilated and found to open into the diverticulum, was divided at its constricted portion just as it entered the sac. The sac was then dissected, free to the bladder wall, and excised. The opening was closed with chromic sutures. The ureter was implanted into the posterior wall of the bladder. The left ureter was seen in the bottom of the pelvis, markedly dilated, probably due to the obstruction caused by the extensive peridiverticulitis. The bladder was drained through a stab wound, and a rubber drain placed in prevesical space. The child was considerably shocked after operation and transfusion was necessary. Temperature reached normal in a few days and then convalescence was steady. The urine which was markedly purulent after operation, gradually became clearer. The bladder wound is now closed, and child voids freely. The right kidney is not palpable or tender. A cystoscopy will be done in the near future to determine whether the neostomy is functionating.

Summary. A boy of 3 years with a history of retention and pyuria of 6 months' duration, found by

cystoscopy and cystogram to have a diverticulum which opened into the right ureter. Operation—excision of sac, division of ureter and reimplantation; recovery

CONCLUSIONS

Vesical diverticula are rare findings in childhood, not more than 30 being found in a review of over 600 cases.

Diagnosis of this condition in children should present no difficulties. Little value can be placed on the history. Physical examination of the abdomen is of considerable importance. A chronically distended bladder especially asymmetrical in outline, should make one suspicious of a diverticulum. The cystoscope and cystogram are absolutely essential in making a correct diagnosis. Of the two, the cystogram will be found more valuable.

No evidences of obstruction, either vesical or urethral, were found in the 3 cases reported in this article. All three diverticula were in immediate proximity to the ureter; in one, the ureter opened into the sac, and as a result, the ureters were compromised to such a degree as to cause obliteration of the lumen, with resultant dilatation. Division of ureter with reimplantation was performed in all 3 cases, with recovery of patients.

Undoubtedly there will be an increase in the number of cases reported as soon as cystoscopy in children becomes more of a routine procedure. The presence of diverticula in patients so young, without evidences of any obstruction, leads one to conclude that they were congenital and that in all probability many of the diverticula in adults have also a similar origin.

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BLADDER NECK OBSTRUCTIONS

Their Surgical Relief in Reference to the Young Punch[1]

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We present for your consideration various phases of bladder neck obstructions and their relief from a surgical standpoint; interesting on account of their frequency, the complexity of their symptoms, the conspicuous place that their relief has acquired in surgery in comparatively recent years, but of still greater interest in the prevention of their inoperable sequelæ.

The pathological physiology of the musculature of the bladder neck with relation to increased tone, spasm, dysuria, tenesmus, and acute or chronic retention, has many times failed to be satisfactorily explained by the clinical symptoms and the pathology actually found at the time of diagnosis or of operative surgical relief.

Anatomically, the bladder neck or internal urethral orifice is not a true sphincter except in function, for its muscular structure is that of a double loop. The upper arc is made up of fibers of the external longitudinal bands of the ureteral muscles, which sweep downward to the level of the urethra, uniting in a loop above without raphé formation. The lower arc is formed by fibers of the internal circular layer, fusing with the upper arc, meshed by fibrous stroma, intimately associated with the trigone, prostatic urethra, the prostate, and its capsule. Covered with a sensitive mucosa, it forms an oval with the greatest mass of its unstriped muscle on the floor; and once esteemed without question to be the muscle of continence, but now discredited in this office in favor of the external sphincter, the duty of which—continence—is ever well sustained except in the presence of traumatic or surgical injury, trophic, or central nervous system disease.

The bladder neck muscle, which may be compared to a sensitive automatic relay station, patient, ever watchful, persistent in its care, even if disregarded in a normal genito-urinary tract, but, when outraged, furious to the extent of tenesmus, is more responsive to the removal of the cause of its insult than any other of the guardian sphincters of the body. Its duties are so important, yet so mechanical, that no pathological condition can exist above or below in the urogenital tract or about the rectum for any long-continued period, without sooner or later seriously involving its muscle tone. The bladder neck and its muscle fibers are seldom primarily at fault in these disturbances, although they have only a certain amount of reserve, their hypertrophy is cumulative in like proportions to the pathological syndrome.

The fundamental change in its poise is a physiological one at first, that is, its normal tone, resiliency, and contractibility are heightened, accompanied with a latency of its secondary functions, which can and will often remain temporarily a physiological process as is seen in acute systemic toxæmias and traumatic shocks to the central nervous system. Subsidence of cause is adverse to the rule in bladder neck pathology, except in acute disturbances, and it is difficult to conceive of a decided obstruction without a preceding change in the normal physiology. After increased tone follows spasm of the muscle tissue; overwatchfulness of the contributing stimuli with resultant like proportion of reflex impulses to the external sphincter producing irritability, frequency and dysuria which are often the patient's first consciousness of anything out of the ordinary. The realization of its meaning is always received with consternation by the neurotic, and by an equal amount of disregard in the physically strong; either may have some focal or systemic infective cause, the existence of which he is unaware.

Long-continued spasm of the bladder neck, whether subacute or chronic, conscious or subconscious, in the subjective interpretation must surely culminate in pathological changes, such as hypertrophy, proliferation of fibrous tissue, and eventual reduction of proportion-

[1] County Medical Association, November, 1921.

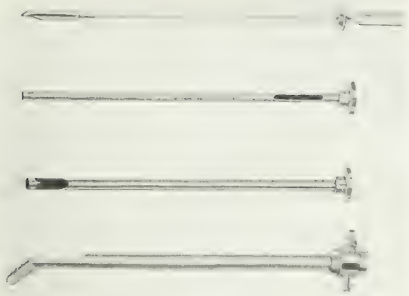


Fig. 1. Braasch punch, noting number of parts and smallness of excisor blades.

Fig. 2. MacGowan modification, identical with original Young punch, with the exception of an additional light carrier.

ate function with loss of resiliency or a beginning contracture of the neck of the bladder; a phase which once established never diminishes; more often increases in severity with all the complications that may follow; a condition which if not relieved early by elimination of its etiological factors and subsidence of the spasm to the extent that the chronic irritative symptoms with residual urine ceases, goes on in an ever increasing vicious circle, the etiology contributing to the secondary obstruction and the sequelæ in like proportion adding stimuli to both; so that such a syndrome will always have a surgical end for the accomplishment of its relief, or if the patient survives the complications that must inevitably arise in its progress, such as diverticula, hydro-ureters and hydronephrosis, and their attendant functional disturbances in total renovesical degeneration and death. We have remarked that a long-continued obstruction, even if not very severe, plays a greater part in the production of diverticula than a rapid and severe obstruction with great strain, and as the majority of diverticula are of necessity, anatomically and through intra-abdominal pressure, located posterior to the bladder neck, they often dissect downward, between the rectum and the prostate, and when distended with urine they obstruct the bladder neck in much the same manner as an intravesical prostatic lobe or posterior median bar.

Why is all this attention paid to a normally subservient and well behaved group of muscle fibers, covered with a reflected mucosa, known as the bladder neck? Because of its mechanical importance. No bladder is normal, no surgical procedure to relieve obstruction can hope to be a success, unless the floor of the bladder is made and maintained on a level with the floor of the urethra, for it then cannot carry residual urine and will assume its former high resistance to the invasion of pathogenic bacteria. It is also regrettable that through the obscurity in its etiology, chronicity of development and lack of early clinical recognition, the majority of cases must eventually seek surgical relief.

The most common factors in the production of bladder neck obstructions, other than prostatic or adenoma in one or more of the Albarran group of glands are the postinflammatory changes in the mucosa following posterior urethritis and cysto-urethritis existing as cysts, sessile and polypoid, pale, yellow or red, with or without vascular markings and adenoid and papillomatous growths, chronically infected follicles or ducts of the prostate or prostatic urethra in any or all of its quadrants. These conditions, although in their onset apparently insignificant, have a distinct set of symptoms, such as intermittent urethral discharge, without infecting organisms, various degrees of difficulty in the voiding reflex with increased frequency,

Figs. 3 and 4 and 4. The original Young median bar excisor open and closed; note the engaging teeth are external to the excisor blade after excision of tissue is made.

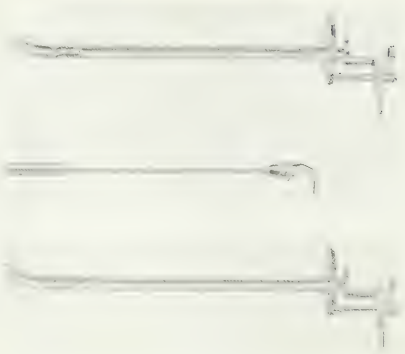
slight or even marked impotence, reflex pain in the anterior urethra, a continuous consciousness of the posterior urethra, and occasional bleeding at the end of urination or hæmaturia, depending on the exact location and character of the pathology.

Excluding the complex obstructions to the voiding reflex, prostatic hyperplasias are most commonly classified as median lobe without median bar formation, lateral lobe with a clinically recognizable median lobe, general hypertrophy, in which neither the middle nor lateral lobes are prominent, and general hypertrophy in which the middle or lateral lobes, or both, are prominent. The surgical relief of the same is today standardized to the extent that we shall not discuss the accepted methods of technique except as to the aid given by a Young punch in assuring a functional result, with the prevention of an undesirable postoperative obstruction. An enormously greater number of prostates have been removed without any attention being paid to possible bladder neck muscle involvement than have been removed after a careful cysto-urethroscopic and cystoscopic study, with due recognition of such lesions present before the time of surgical interference. Why? Because of the lack of knowledge of the significance of the findings to be obtained by this means and no other. For bladder neck obstructions, depending upon their type, and the multiplicity of types that may be found in any one individual, give a definite indicative group of symptoms, that are often overlooked, except by the discerning urological clinician, who is able to visualize the pathology present. Symptoms of prostatic hyperplasia without prostatic findings together with slowness in starting the stream, increased length of time necessary to empty the bladder, diurnal and nocturnal frequency, difficulty of expulsion, often disagreeable dribbling, temporary retentions, various degrees of impotence, and the other symptoms heretofore mentioned all point to definite bladder neck muscle involvement, the nature of which must be determined by cystoscopy, cysto-urethroscopy, palpation of the bladder neck to note its thickness, between the shaft of the instrument and the examining finger in the rectum, and repeated examinations for the amount of residual urine, which varies according to the phases of bladder neck relaxation. Further there is abnormal resistance to the passage of rigid instruments and especially a cystoscope, a sense which can only be appreciated after long experience, but which has nothing in common with the normal resistance of the patient, which is often increased to a degree of an apparent contracture by the introduction of a metal instrument in the hands of the unskilled. This resistance ranges from a slight sense of spasm at the bladder neck to that of penetrating a tube of wet harness leather; and the necessary amount of depression of the handle of the instrument toward the perineum for the introduction of its beak into the bladder varies in a like proportion to the pathology present. Even so, there is occasionally a universally contracted vesical outlet, that is fibrosed but offers no special resistance to the beak of the cystoscope on attempted intro-

duction or withdrawal, and which admits an ordinary sized Van Buren sound, but which is found at the time of opening the bladder to be a definite contracture, dimple like, with little or no resiliency, raised upward in the bladder or swung loose in a curtain-like membrane, depending upon whether it is associated with chronic prostatitis, prostatic atrophy or prostatic hyperplasia.

Numerous well-trained urologists, dominated by the fear of producing incontinence if the neck is disturbed for any other purpose than the removal of the growth, have refused to recognize this general contracted, nonresilient vesical neck, even when with the bladder open they can see and feel it. But none can refuse to acknowledge the brilliancy of the results obtained usually by the aid of a Young punch in removing the inflammatory tissue, not only as a groove upon the floor, but around the entire circumference of the involved vesical ring. It is well to direct attention to the fact that the true pathology of the bladder neck in reference to a generalized contraction of the entire vesical ring is often camouflaged by œdema. Therefore, at the time of cystoscopic diagnosis, one is apt to be misled. Digital examination of the internal orifice at the time of the initial cystotomy for drainage does not always insure against the surprise of finding on the day of major relief, the obstruction to be a postinflammatory band, a true fibrosis, or generally contracted bladder neck coarctation which does exist, with and without median bar formation, in all forms of prostatic hyperplasia and postinflammatory prostatic atrophy.

Can you imagine this fibrosis as being possible of occurrence without the presence of increased tone, chronic spasm, hypertrophy, increase of connective tissue, atony or atrophy of muscle, scar-tissue contraction, and last of all, that super sclerosis in which degenerative possibilities naturally, to the experienced clinician, suggests the type as potentially or probably malignant. The fact that so many of these cases are not diagnosed before they reach the borderline of the hopeless stage must be due to the fallacious interpretation of the symptoms in their incipiency.



Figs. 5 (at top) and 6. Parker-MacGowan modification of excisor of Young; note an obturator is no longer necessary and the engaging teeth are internal to the excisor blade, after tissue is excised.

A definite sclerosis of the bladder neck, in which the symptoms, etiology, and morbid anatomy of its development does not differ materially from that accompanying post inflammatory atrophy of the prostate, is rare except in obstructive cases of extremely long standing, where the bladder musculature has undergone immense hypertrophy with fatty and fibrous degeneration, or cases with mobile vesical calculi, which contribute by constant traumatic irritation of the orifice direct to its progress; a class to which it is difficult to give permanent relief, and which show a very high percentage of malignancy. (For these and many other reasons it is essential that a microscopical examination be always made of sections taken from all parts of bladder neck obstructions.) Another type of obstruction is the postoperative contracture which may occur following either the suprapubic or the perineal method of enucleation, and is no more common by one approach than the other, where the operator disregards the possibility of the presence or possible development of vesical neck fibrosis at the time of operation. Prostatic enucleation without the so-called wounding of the internal sphincter occasionally results in a dimple-like contracture set in a tympanum-like fold of the lower bladder segment above the cavity of enucleation and

below the trigone, which also may suggest, by way of description from the bladder side, a prolapse of the anterior bladder wall which carries the internal orifice downward acting like a loose curtain attached on all sides. This complication occurred to a marked degree in one of the earlier cases of our series, following a prostatic enucleation suprapubically. Had a Young punch been used to a greater advantage at the time of the prostatectomy, it would not have been necessary to perform a secondary punch operation, removing the contracture tissue over the entire circumference of the bladder ring, of sufficient depth to feel resilient muscle, in order to obtain a functionally perfect result. The same condition has followed the perineal method of enucleation with the bladder closed and was much more difficult of relief. Also during this series, consultations backed by authentic records have been requested in a certain percentage of cases of perineal enucleations applying afterward to us where no attention was given to an existing contracture by the operators, and therefore were followed by a poor functional result, which necessitated a second surgical interference. There were two other cases we mention with reluctance because though a definite generally contracted bladder neck was recognized upon attempts to excise a groove on the floor, the punch would not engage in the fibrous bladder neck, but did catch in and remove a goodly portion of the prostatic urethra in both cases. As for the suprapubic method, the necessary and unavoidable trauma incident to the ordinary enucleation, preventing a too rapid restoration of the internal sphincter before there is a coaptation of the lower bladder segment to the outer wall of the prostatic capsule and the prostatic urethra, probably explains why this complication does not follow all prostatectomies, especially those with clinical findings, suggestive of contracture and the large hyperplasias with collar-like protuberances around the bladder neck. In this type of case a Young punch has been found a most valuable aid, first, in the dividing of the internal sphincter, posteriorly, preceding an enucleation and, second, if the necessity arises, in dividing a hypertrophied and undermined trigone, following the enucleation, procedures that have since their adoption been a marked factor of safety, in that the enucleation is done with greater ease, permanent provision is made against the closing of the vesical orifice by inflammatory adhesions, and the annoyance of the presence of a shelf of the trigone overhanging the prostatic cavity with its pocket into which instruments of all kinds find their way instead of entering the bladder, in which stagnant urine lies promoting dribbling and stone formation, is prevented and avoided.

1. We wish to compare the different forms of punches or so-called median bar excisors, some of which are not limited in their use to a small quadrant of the bladder neck, posteriorly or to superficial tissue, which may obstruct the urinary outlet. First the Braasch punch, which is electrically lighted on the same plan as the direct Braasch cystoscope, a feature of value in attempting bladder neck obstruction removal with the bladder closed, but of no aid in the MacGowan modification of Young's technique, of approach either through a perineal urethrotomy or suprapubic opening. The greatest disadvantage is the smallness of the section removed. The second disadvantage is the number of parts; although they are simple and the instrument is easy of operation, if properly cared for, their simplicity cannot be compared to that of an instrument consisting of only two essential parts, an excisor shaft and a cutting blade.

2. Next is shown the MacGowan modification of the Young punch, the same as the original, except for the sheath light carrier which is not any more efficient than the lighting system of the direct Braasch, although it does give a better lighted field than the transmitted light of Young punch. The only objection, other than those shown later to the Young punch is the increased size of the instrument in accommodating a light sheath.

3. Third is shown the original Young median bar excisor, a classical instrument but a dangerous one even in skillful hands. You will note the immobilizing teeth are on the outer surface of the obdurator when in place,

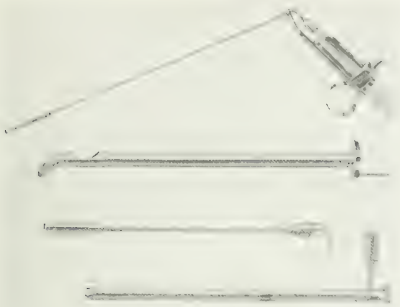


Fig. 7. Caulk modification of Young punch with electric cauterizing blade.

as also outside the excisor blade after the excision is made, hence subject to being bent outward by dense obstructions, and when this happens, unmercifully lacerate the bladder neck and urethra upon withdrawing the instrument. It becomes engaged easily in tissues not intended for engagement, and there is much difficulty in freeing its hold, except by forward motions, as lateral motion often increases the difficulty or renews it in a possibly more disastrous location. The teeth have broken off, have chipped the blades and have been caught in all manner of disagreeable locations from the ureteral folds to the meatus, to the extent that according to urological history suprapubic cystotomy and external urethrotomy have been necessary to free their awful hold. The writer's greatest shock from the lack of faith in the teeth of this instrument arose after a dense section of fibrous tissue was excised from the bladder neck, using a heavy cutting pressure when one of the teeth bent outward. Withdrawal of the sheath and blade containing the section was also accompanied by a strip of urethral mucosa 2½ inches in length from the floor of the posterior and anterior urethra. Although recovery was uneventful, the inevitable result of chordee, with which he was unacquainted before was a nightly visitor for a long time thereafter.

4. MacGowan and myself, operating with mechanics, have again taken the liberty to

Fig. 8. Young's modification of original punch, in which necessary engaging teeth have been discarded.

modify the original Young punch, thereby producing a safe instrument, so far as concerns any of the former elements of danger. The teeth are on the inside of the obdurator, an accessory no longer necessary. This modification cuts clean, does not tear, does not become engaged where not desired, and should this occur from being unintelligently placed, is easily disengaged by lateral as well as forward motion. There is no danger of breaking or bending of the teeth, which are built up in the instrument in the form of small pyramids with relatively broad bases and when the excision is made, the teeth are on the inside of the blade, making the withdrawal of the sheath as harmless as that of a sound. The fact that the immobilizing teeth are on the inside does not lessen the efficiency of the instrument, and there are no tissues in the bladder neck, prostatic capsule, or trigone that any operator has a surgical right to remove with the original punch, that cannot be just as easily removed with the modification. The use of the latter in the last half of our series has reduced postoperative rises in temperature; tenesmus, and epididymitis have been much more infrequent, the average convalescence is shortened. Still more gratifying since the use of the modification, not a single postoperative hæmorrhage has occurred whereas before in 20 per cent of contracture operations alarming hæmorrhages were frequent, some of which required the use of a Hagner bag or suture of the bladder neck for their control.

5. Dr. John Caulk at a later date has also modified the Young punch by adopting an electric cautery cutting blade, instead of the cold knife excisor blade, and has ruled out

the teeth entirely, depending upon the congealing quality of the heat for immobilization of the tissue to be excised and withdrawn. In cases requiring minor relief, it is superior to the original Young punch or any of its modifications, but it is yet to be proven of equal value in those requiring major relief from dense contractures nor is it reasonable to assume in these cases that convalescence will be shortened, and possibilities of complication be lessened through a burning operation where a slough must be thrown off before granulation is complete.

6. The latest Young punch modification is the original instrument, without any teeth for engagement of tissue to be excised, a radical change, indeed, from a dangerous instrument, considered useful, to one that would appear to lack all of its former efficiency. Might not its use, from a mechanical standpoint, lead to poor surgical results, through lack of proper immobilization of the obstructions necessary to be removed, not to mention the loss of sense of touch in the tissues desired to be engaged?

CONCLUSIONS

1. That due to recent research on living patients with definite clinical entities of bladder neck obstructions, and not upon necropsies of those with advanced types of obstruction, more attention to diagnosis and relief forces a conclusion that posterior median bars exclusive of the Albarran type of hypertrophy are not so common as generally believed, and that a widely contracted bladder neck will be found a most common cause in the fourth and fifth decades for progressive vesical irritability and retention, that the causative influences are often not only local infections, but remote foci and systematic toxæmias.

2. That the method of choice for classical contractures of the bladder neck of all types requiring major relief are best approached by the MacGowan modification of Young's technique, either suprapubically or through external urethrotomy incisions, for the educated finger is far superior to poor light illumination and to the same touch through an instrument intra-urethrally in determining the removing of scar tissue to the level of resilient muscle, so that one may know the floor of the bladder again to be level with the floor of the urethra. Further, the operator may rest assured that the greatest of all dangers following this type of surgery, — hæmorrhage,— is easily prevented and controlled.

3. That the modified Young punch or median bar excisor is to date the most efficient and safe instrument that is not limited in its field, for surgical relief of the bladder neck, associated with prostatic atrophy, prostatic hyperplasia, vesical calculi, or hypertrophied trigone.

4. That it is a most valuable aid, preceding, during, and following prostatic enucleation for incising the bladder neck and trigonal shelf, removing capsular tags, and small portions of prostatic tissue that are difficult of immobilization.

5. That a more satisfactory explanation is yet to be advanced as to bladder neck tone and the etiology of irritability, hypertension, spasm, and tenesmus, in reference to the production of contractures of the mechanical type.

6. That the mortality rate has been nil, that hæmorrhage, although all former precautions were employed, has not occurred in bladder neck obstruction, relieved by use of the modified Young punch; that postoperative absorption is less, and convalescence is shortened. Epididymitis in males past the procreative age is prevented by vasectomy. Last, but not least, the preparation of the patient for any type of major bladder neck surgery is of the utmost importance.

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A CLINICAL INVESTIGATION OF VULVOVAGINITIS[1]

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VULVOVAGINITIS may justly be termed a free lance disease. Although physicians in diverse specialties accept the condition for treatment, there is no uniformity in diagnostic procedure or mode of therapy, or is there any accepted plan of procedure endorsed by a single specialty. The treatment of the condition in the hands of various specialists varies from simple hygienic measures to the most painstaking local applications, but it is for the most part empirical and frequently irrational.

About a year ago a joint meeting was called of the gynecological and genito-urinary departments of the Michael Reese Hospital Dispensary to discuss the problem of the disposition of vulvovaginitis patients. No agreement could be reached. One physician claimed that all the cases were gonorrhœal; another said they were never gonorrhœal; one held they always arose from contact, and another believed filth was the sole cause.

With such diversity of beliefs as to etiological factors, naturally no plan of procedure could be outlined, and it was decided to investigate the cause of vulvovaginitis, clinically and bacteriologically.

To learn whether or not this chaotic condition in reference to vulvovaginitis was peculiar to members of our staff, or typical of the profession of today, a questionnaire was recently sent out to six special groups of physicians or institutions, comprising ten pediatricians, six general practitioners, ten urologists, ten gynecologists, five contagious disease hospitals, and nine orphanages. The questions asked were:

1. Do you treat vulvovaginitis in little girls?
2. Upon what criteria do you base your diagnosis?
3. What do you believe to be the cause of the condition?
4. How do you usually treat the condition?
   A. By whom is treatment carried out?
   B. How often?
5. What is the usual duration and course?
   A. What complications?
6. Upon what criteria do you determine cure?

Of the fifty questionnaires sent, thirty replies were received. Of the thirty who replied, nineteen, comprising six pediatricians, three general practitioners, three urologists, five gynecologists, one contagious hospital, and one orphanage, answered Question 1 in the affirmative.

Question 2 was answered by nine that diagnosis was made by the presence of vaginal discharge; nine by smears; and one by culture.

[1] Read before the Chicago Gynecological Society, June 16, 1922. (For discussion, see p. 123.)

Question 3, ten answered gonorrhœa either alone or mixed with other organisms, seven non-gonorrhœal infection; one uncleanliness; one masturbation; one worms; one direct or indirect contact.

Question 4, twelve used silver salts in solution or ointment; two used mercurochrome instillations; four advised irrigations; two, hygiene alone.

Question 5. The majority answered that the course varied indefinitely from 1 month to 6 or 9 months and recurrences were not infrequent; one answered, course, 1 week to 10 days; one never felt sure of cure. Ten of the nineteen never saw complications, while arthritis, endocarditis, ophthalmia, pruritis, bartholin abscess, urethritis, pyelitis, were each mentioned once; pyosalpinx and cystitis each twice.

Question 6. Ten gave no definite criteria of cure. Four considered disappearance of discharge and negative smears sufficient, but no definite number was stated. Three said cure was obtained on disappearance of clinical signs; two, on negative smear or culture after provocative silver injections; one said microscopic examination determined cure, but did not state what was to be found upon examination.

This evidently is the status of vulvovaginitis today. Apparantly no group considers the cause of the disease the same. Although this is a summary of but a small number of inquiries, it is representative and sufficiently varied in special practice to prove the utter lack of uniformity in our comprehension of the disease. Is this lapse due to the scarcity of literature upon the subject? Not at all, but no two authors accept the same etiology, and therefore they fail to agree on diagnostic methods and therapeutic procedures.

For instance, in reports of clinical investigations of the subject we find that Spaulding reported 83 cases of vulvovaginitis of which 56 were gonorrhœal; 9 non-gonorrhœal; 1 associated with acute infectious diarrhœa; 1 with pneumonia, and 1 after a fall. She mentions a non-specific variety following chicken pox and measles due to staphylococcus and streptococcus.

R. M. Smith says there is a definite group of vulvovaginitis with variable non-gonorrhœal bacterial origin and reports two cases in which micrococcus catarrhalis was found.

In the Johns Hopkins Dispensary, Hurdon found 63 per cent of the cases to be gonorrhœal.

Robinson gives among the causes of nonspecific vaginitis, uncleanliness, decomposing smegma, urinary incontinence with decomposition, traumatism from masturbation or rape, and also states that there is a very infectious variety in which the gonococcus cannot be found.

Abt, in presenting this subject before the Venereal Disease Institute on March 15, 1922, said that 70 to 80 per cent of children with vulvovaginitis had gonorrhœal infection. Indirect contact, he stated, was the mode of transmission, and that "bad technique" was responsible for 98 per cent of the cases. By this he meant common sleeping quarters, toilet seats, bath tubs, public baths, swimming pools, wash cloths, underclothing, etc. Occasionally direct contact, as in cases of sex violence, is the mode of infection. Institutions were emphasized by Abt as an especially potent factor, there being rapid spread of the infection after the admission of an infected case.

Epidemics of the disease have been frequently reported, the earliest being the one reported by Atkinson (1878), according to Baer who in 1904 summarized the literature on this phase of the subject and reported the results of an investigation of a hospital epidemic of 13 months' duration. He also cites the interesting report of Skutsch (1891) of the infection of 236 girls with gonorrhœal vulvovaginitis, contracted in a public bath, none of the boys using the same bath becoming infected.

Apparently there are three distinct types which require recognition; the acute gonorrhœal, the non-specific, and the epidemic type (usually gonorrhœal). Each type is capable of further differentiation into acute and chronic or recurrent and into severe and mild forms.

Under diagnosis, also, we find a lack of harmony in the literature.

Fig. 1. Fireless cooker (Stein-Burn) and copper carriers for transporting cultures without chilling.

Fig. 2. Fireless cooker, showing the warming brick and the asbestos pad.

According to Norris, the presence of discharge and the finding of gonococci in the smear is diagnostic. The difficulty of detecting the organism in chronic cases when discharge is scant is emphasized. Suspicious cases should be ruled out only after three negative smears taken under favorable conditions for finding the organism.

Warden states that the staphylococcus urethræ is often taken for the gonococcus in smears and that cultures alone can differentiate them.

Fischer describes a yellow and a white diplococcus in the vagina in simple catarrhal vaginitis in which gonococci are never found.

Norris and Mickelberg are of the opinion that clinical evidence is of greater diagnostic value than the stain method for, in the chronic stage of gonorrhœa, the discharge is scant, gonococci few, and may be atypical morphologically and tinctorially. They warn that other cocci may be present which may confuse one; and that some strains of gonococci are more susceptible to certain stains than others, and that there may be errors in the performance of Gram's stain. A diagnosis made by the staining method is of no value except when made by one skilled in this work and negative results have no significance unless frequently repeated. They advise obtaining smears from centrifuged washings of the vagina, using a soft rubber eye syringe. Kolmer advocates cotton swabs wet in weak bichloride solution moved about in the vagina and then rolled, but not rubbed, over the slide.

Rubin, after studying 255 cases in the Mt. Sinai Dispensary in New York, concludes that too much value is placed on the smear examination. He believes that the diagnosis rests upon cultural and serologic tests. Provocative silver injections have been recommended by many as an aid in obtaining positive smears.

Under the caption of "treatment," we find very little emphasis placed upon prophylaxis. Abt, however, urges isolation of cases, especially in institutions, and the temporary isolation of all admissions to children's institutions until three negative smears are obtained. He emphasizes the importance of a general technique of asepsis in the handling of children including the wearing of gloves by the nurse, and the use of individual beds, thermometers, soap, towels, bed pans, etc.

Of the many methods of active treatment described in the literature, a few will reveal the diversity of opinion.

Gellhorn in 1920 described the method used in treating vulvovaginitis in the City Hospital, St. Louis, Missouri, consisting of daily injections into the vagina of a 1 per cent silver nitrate in an ointment of equal parts of lanolin and white vaseline. Discharge and excoriations disappeared rapidly under this treatment and the average duration of treatment was 3 to 4 weeks. The treatment is

TABLE I.—SUMMARY OF ANSWERS RECEIVED FROM QUESTIONNAIRE

Group	Do you treat cases of vaginitis in young girls?	Upon what criteria do you base your diagnosis?	What do you believe to be the cause of the condition?	How do you usually treat the condition? a) By whom is treatment carried out? b) How often?	What is the usual duration and course? a) Complications?	Upon what criteria do you determine cure?
	1. Yes	Vaginal examination and the finding of gonococci, the usual negative clinical results and occasionally complete recovery with irrigation of vagina		By mercurochrome 1 to 5 per cent. Mother is instructed at the office. Once to twice a day.	From a few to many months. Arthritis, pruritus, endocarditis, and ophthalmia.	Absence of discharge and repeated negative smears.
	2. Yes	Gonococcus infection. Leucorrhea.	True cases contacts. We see many pseudo cases non-specific in most of which the diplococcus is usually gram-negative if a diplococcus is present.	One per cent silver nitrate in vaseline, package of a gram by syringe with rubber tip. By nurse or mother. Once or twice daily. Vulvitine it by mother and once daily.	Two to 6 weeks with not infrequent recurrence of a milder type and fewer organisms. Very few except occasional cystitis.	Repeated negative smears taken at intervals of at least 3 days.
	3. No					
	4. Yes	Positive smears for gonococcus. Leucorrhea.	Frequently gonorrhea, sometimes colon bacillus infection.	Two per cent silver nitrate in equal parts lanolin and vaseline. Internes or nurse at hospital or by myself at office. Three times a week.	About 3 months with this treatment. Have seen arthritis. Pyosalpinx.	Disappearance of discharge microscopically. Disappearance of discharge per se and bacteria microscopically.
GROUP ONE	5. Yes	A vaginal discharge with many gonococci, leucocytosis, and other pathological and examinations.	The gonococcus. I believe that the majority of cases diagnosed as gonorrhea are not due to the gonococcus and are not gonorrhea. In other words, I do not believe the ordinary laboratory diagnosis is reliable.	Daily injection of 1 per cent silver nitrate in equal parts of lanolin and petrolatum. Mother or nurse. Once a day. Nothing else. No irrigations.	Of true gonorrhea, a month or two. Of these commonly diagnosed as such, many months. None were observed.	Prolonged absence of discharge and of specific organisms. Practically in the hospital clinic negative smears.
	6. No					
	7. Yes	Positive smears, etc.	Infection.	Permanganate, argyrol, 1 per cent silver nitrate, lanolin and vaseline. Mother, nurse, self. 6. Once, three times a day.	One to 3 months. None.	Decrease pus, with, smear, no germs.
	8. No					
	9. Yes	Positive bacteriological and clinical findings.		Permanganate and silver salts. Mother or nurse. Permanganate twice daily. Silver 2 to 7 times per week.	Tendency to recur throughout childhood. None.	Disappearance of discharge. Negative microscopical findings. Patients warned "cure" is not to be considered permanent until year or more has passed without recurrence.
	10. No answer					

TABLE I.—SUMMARY OF ANSWERS RECEIVED FROM QUESTIONNAIRE—CONTINUED

Question	Do you treat vulvovaginitis in little girls?	Upon what criteria do you base your diagnosis?	What do you believe to be the cause of the condition?	How do you usually treat the condition? (a) By whom is treatment carried out? (b) How often?	What is the usual duration and course? (a) Complications?	Upon what criteria do you determine cure?
	11. Yes	Bacteriological and clinical.	Gonorrhœa in some, infections with other bacteria in others.	Symptomatic. By myself and mother or nurse. Dependent upon the case.	The chronic cases, many months. In my practice the average treatment was 9 months. I had one acute Bartholin abscess in a girl of 3 years. Pelvic peritonitis.	Clinically and to some extent bacteriologically.
	12. Yes	Microscopic examination.	Sometimes gonorrheal. Sometimes not gonorrheal. Catarrhal.	Most careful local cleanliness. Argyrol solutions and astringents and gauze wicks. By mother if intelligent or by competent nurse. Once, twice, or more times daily.	Varies, in gonorrheal cases, weeks. Urinary, urethral. Probably pelvic organs (?). Of latter I am not positive.	Relief of local symptoms. No redness. No discharge and microscopic examination.
GROUP TWO	13. No answer					
	14. No answer					
	15. Yes	Try to find organisms and clinical findings.	Specific and non-specific organisms.	Local douche applications silver nitrate, 1:5 per cent argyrol to 2½ per cent bichloride, permanganate irrigations. Boric pads. Physician, nurse or parent in office or home, mostly home. Local applications about two times weekly, irrigations daily, governed by reaction on tissues.	Mild, non-specific, from a few weeks; specific and neglected, several months. None in my few cases.	Disappearance of local manifestation with no return of symptoms for several months following.
	16. No answer					
	17. No answer					
	18. No answer					
	19. No					
GROUP THREE	20. No answer					
	21. Yes	Gonococci (Gram negative or extracellular in back wash from vagina).	Gonococci most often. Occasionally colon bacillus.	Home. Vaginal irrigations of 1:1000 silvol solution. Office, instillations of mercurochrome 220 and tampons for 12 hours. Mother or nurse at home. Physician at office. Twice daily at home; three times a week at first at office; later once a week.	Varies much in our experience, 2 weeks to 6 months. Vaginal adenitis is the only one we have seen often. Occasionally urethrocystitis.	Injections of 1 per cent silver nitrate followed by three negative cultures in wash water under sterile conditions.

TABLE I.—SUMMARY OF ANSWERS RECEIVED FROM QUESTIONNAIRE.—CONTINUED

Group	Question	Do you [illegible] vaginitis [illegible]	Upon what criteria do you [illegible] your diagnosis?	What do you believe to be the cause of the condition?	How do you usually treat the condition? (a) By whom is treatment carried out? (b) How often?	What is the usual duration and course? (a) Complications?	Upon what criteria do you determine cure?
GROUP THREE	13	Yes	Microscopic findings.	Usually the gonococcus at least in the early weeks.	By irrigations with catheter and instillations of solutions of silver salts used in vagina and urethra. By nurse if possible three times a day.	Indefinite, some are protracted and clear up after incision of hymen when opening is small. Have never seen any complications.	Cessation of discharge and microscopic findings. [illegible]
	14	No answer					
	15	No					
	16	Yes	Culture only.	Uncleanliness.	Extreme cleansing, instillations into vagina with medicine dropper. Mother if intelligent, otherwise nurse. Two to three times daily.	Cannot be estimated. Have never seen any complications except once in a specific case. Bilateral pus tubes.	Disappearance of discharge and negative smears.
	17	No answer					
	18	No					
	19	No answer					
	20	No answer					
	21	No answer					
	22	Yes	Discharge from vulva. Microscopical [illegible] of discharge and [illegible]	Gonococcus.	Instillations in vulva, vagina, and urethra, 25 per cent argyrol. Myselt. Daily.	Eight weeks in the most cases. Indefinite in others where the infection is in the urethra. None so far.	Never felt positive that I cured any of them. Have a number in which microscope does not at present reveal any bacteria.
GROUP FOUR	23	Yes	Redness of involved area and discharge or discharge alone.	1. G. C. 2. Maceration, due to uncleanliness.	Instillation with medicine dropper of 2 per cent silver nitrate into vagina and subsequent douching with mild astringents. Mother or nurse. Once or twice a day. Often enough to keep discharge from irritating.	Months. Chronic infection of Skene's ducts. Ordinarily nothing more.	Absence of visible discharge.
	24	Yes	Microscopic diagnosis on smear.	Gonococcus often. Other bacteria often.	Hygiene, external lysol washing. Nurse or mother. Constantly.	Duration—weeks or months. Course—no complications, healing. None observed.	Microscopic examination of smears.

TABLE I.—SUMMARY OF ANSWERS RECEIVED FROM QUESTIONNAIRE—Concluded

Question	Do you treat vulvo-vaginitis in little girls?	Upon what criteria do you base your diagnosis?	What do you believe to be the cause of the condition?	How do you usually treat the condition? (a) By whom is treatment carried out? (b) How often?	What is the usual duration and course? (a) Complications?	Upon what criteria do you determine cure?
GROUP FOUR	34 Yes	Evidence of inflammation. Nature and persistence of discharge.	Sometimes due to small worms inhabiting the lower rectum, crawl into the vulva and cause itching which causes the child to rub and favor infection.	Mild antiseptic solutions carefully injected. Argyrol if necessary. Mostly by the mother. Daily.	From a few weeks to months according to the nature of the infection and efficiency of the treatment. Have not seen any of a serious nature.	Chiefly cessation of the discharge and absence of gonococci in case of gonorrhœa.
	35 Yes	Discharge, inflammation and microscopic examination.	Infection.	External boric irrigation and instillations of 25 per cent argyrol. Myself and nurse, or mother. Irrigation daily, argyrol same at first.	One week or 10 days. None	Absence of inflammation and negative micro-scopic.
	36 No					
	37 No					
	38 Yes	Vaginal smear positive for intracellular diplococci.	Direct or indirect contact with the organisms.	One per cent silver nitrate ointment tampon into vagina twice daily. Supervision nurse, twice a day.	Several weeks to months. Pyelitis occasionally.	Discharged when three successive smears are negative for gonococci.
	39 No answer					
	40 No answer					
	41 No answer					
	42 No					
GROUP FIVE	43 No answer					
	44 Yes	Presence of discharge and specific organism.	Organ infectious nature. Decrease of the infection depends upon the organism. Mercurochrom also produces such a condition.	Clean-ing the part with boric acid solution and instillation of argyrol into vagina. Graduate nurses. Two to 3 times daily.	Each case varies. Not definite. None observed.	Absence of discharge and repeated negative vaginal smears.
	45 No answer					
	46 No answer					
	47 No					
	48 No					
	49 No answer					
	50 No answer					

simple and can be entrusted to nurses or mothers under supervision. With this method the number of weeks in which children are evacuated is less than the number of months formerly required.

Wacho and Mazer, after failure with Hirst's silver paste, recommended the use of 1 per cent Dakin's oil instilled daily with a medicine dropper, the child in Trendelenburg position. Of 58 chronic cases so treated, improvement was marked in 1 month. Twenty-five cases were cured in 3 months, and 39 were cured after 4 months. Six cases remained uncured. As recurrences were observed in 1 to 4 months after an apparent cure, the authors emphasized the necessity of prolonged observation.

Wolff reported excellent results in 40 cases treated by vaccines (autogenous), no other treatment except cleanliness being used. Abt says vaccines are valueless. Graves, however, states that the benefits from the use of vaccines in vulvovaginitis is so well established that it should always be adopted as a specific part of the treatment.

Reports of the effect of raising the body temperature in gonorrhœal patients have arrived recently from abroad. Following the publication of Weiss, who reported the favorable effect of prolonged hot baths upon fifteen soldiers with acute gonorrhœa, Engwer treated a 3-year-old girl suffering from gonorrhœa of the vulva and anus with a bath at 42° to 44° C. for one-half hour. Two days later the child was cured and she remained so. Ylppo and Bendix each reported a case of vulvovaginitis cured with daily prolonged hot baths. Risseoloda, Scholtz, Nast and Schulz had less favorable results and finally gave up the method. Schulz reported instances of delirium, fainting and cramps following the hot baths. Of 20 cases treated, *no cures* were obtained. The children complained of severe headaches and restlessness; they became weak and drowsy. Schulz warns against the use of thermal baths for children.

Lode used thermal baths also in 7 cases without cure and concluded that the danger to the child is out of all proportion to the benefit gained.

This brief citation of the literature suffices to emphasize the necessity of co-ordinating the mass of material in hand and of presenting an accepted classification of etiological factors and a rational therapeutic program.

In March, 1921, a vulvovaginitis clinic was organized at the Michael Reese Dispensary, and the following procedure suggested by Dr. O. T. Schultz was accepted as a working plan:

All cases appearing at the children's examining clinic with clinical evidence of vulvovaginitis and those having suspicious or positive smears were referred to the special clinic. These were considered gonorrhœal until proved otherwise. A positive gonorrhœal diagnosis was accepted if upon smear examination the following were found: pus cells, with gram-negative intracellular diplococci with typical gonorrhœal morphology. Smears were held suspicious if gram-negative diplococci were extracellular only. To determine whether the organisms in the positive smear cases were truly gonococci or not, cultures were made, the reduced oxygen tension method of Wherry and Oliver as recommended by Herrold being utilized. The cultures were kept warm during transportation from the dispensary to the Institute of Research, in a fireless cooker (Stein-Burn). The smears and cultures, all obtained personally by the essayist, were examined by Miss Ruth Anderson of the Nelson Morris Institute for Research. A wire loop was used in obtaining all culture and smear material.

The summary of our bacteriological results is reported here. A complete report of the same will appear in detail at a later date.

A total of 66 children ranging from 3 months to 14 years of age were treated in the clinic.

1. Fifteen cases (25 per cent) gave a positive smear. In 7 of these the gonococcus was isolated by culture, and in 8 the cultures proved negative for gonococcus.

2. Eight cases were classed as "suspicious," coming to the clinic with a diagnosis of gonorrhœa from a smear examination made in the dispensary. However, all of the smears and cultures made by us proved negative. These were all chronic or recurrent cases with but slight clinical evidence of infection.

3. Twenty-six cases presented the clinical picture of vulvovaginitis. All smears and cultures were negative for gonorrhœa.

4. Seventeen cases were referred by the children's examining clinic as probable vulvovaginitis, which presented insufficient evidence, both clinically and bacteriologically, to be included in the vulvovaginitis group. Excluding this group from the percentage calculation, over 30 per cent of the cases of vulvovaginitis were gonorrhœal.

In addition to the above, two adults' cases are reported:

1. The mother of a three-months-old baby was examined, the infant giving a history of gonorrhœa from birth, with repeated positive cultures and smears. Repeated cultures and smears of mother were negative.

2. A single girl of 18 years, with an acute gonorrhœal urethritis and endocervicitis was used as a control on our cultural methods. Several cultures proved positive in this case, taken in the same way and transported the same days as many cultures of the positive smear cases in which no gonococci could be cultivated.

There were no cases in which cultures were positive and where the smear was reported negative. There were 8 cases in which the smears were positive and the cultures were negative. Thus it appears from our results that the smear diagnosis is sufficient if the smears are examined by an expert, and cultures are unnecessary. If the positive culture were requisite for diagnosis, one-half of our cases of gonorrhœa would have escaped detection. Given a case presenting the clinical picture of vulvovaginitis, and a smear presenting many pus cells with diplococci having the typical gonococcal morphology which are intracellular and gram-negative, a positive diagnosis can be made.

All suspicious and positive cases were treated by us with daily injections into the vagina of an ointment composed of 1 per cent mercurochrome-220 in equal parts of lanolin and vaseline. (Gellhorn's method, substituting mercurochrome for silver nitrate.)

Smears and cultures were taken at beginning of the treatment, again after 2 weeks of treatment with 1 day of rest, and at weekly intervals until three successive negatives were obtained, a week apart. Treatment was then suspended, smears and cultures being taken again in 2 weeks, and if negative finally, in 3 or 4 weeks, to determine cure. No other treatment was permitted except that a *daily tub bath was prescribed.*

Treatments were with few exceptions given by our dispensary graduate nurse, Mrs. Shinn, under our direction. In two instances the mothers were entrusted with treatments after personal instruction at the clinic, and in a few, a visiting nurse carried out the treatment under supervision of our nurse when children could not be brought to the clinic.

The method of treatment which we employed was that described by Gellhorn, and in our experience the mercurochrome 1 per cent ointment proved very satisfactory. The method is simple, painless, and effective, none of the patients complaining about the staining of the skin or clothing.

Summary of the cases treated:

1. *Gonorrhœal—15 cases.* Seven discharged cured in 6 to 16 weeks or in an average of 9.7 weeks. Three still under treatment, 2 of which came to the clinic within the month and 1 (birth infection) is exceedingly refractory, being under treatment 5 months. Two were delinquent in attending the clinic and were transferred to the Frances Juvenile Home. One failed to report for final determination of cure after 10 weeks' treatment and 1 negative smear and culture. Two recurred. One with mild clinical signs was treated irregularly for 4.5 months. The other giving history of vulvovaginitis following rape 1 year ago, cleared up in 8 weeks and suffered recurrence after an attack of measles, and is still under treatment.

2. *Suspicious gonorrhœal—8 cases.* Seven discharged cured in 3 to 11 weeks, or on an average of 6.5 weeks. One treated irregularly in our clinic, at Cook County Hospital and partly by a visiting nurse, and is still under observation.

3. *Non-gonorrhœal cases—26.* Ten resembled the gonorrhœal cases clinically and were treated in the same manner with cure in an average of 5 weeks. Eight were discharged in 3 weeks after three negative smears and cultures were obtained, daily tub baths being the sole treatment. Five were discharged in 2 weeks after two negative smears and cul-

tures, daily baths being the sole treatment. Two cases are still under observation. One recurred after 3 months, giving slight clinical evidence of vulvovaginitis but with negative smears and cultures.

Summarizing our results of treatment we may say that gonorrhœal vulvovaginitis can be cured by daily injections of 1 per cent mercurochrome ointment into the vagina in an average of 9.7 weeks. That suspicious cases can be cured in 6.5 weeks, and non-gonorrhœal cases in 5 weeks.

In 2 gonorrhœal cases recurrence occurred after contagious disease (chicken pox, measles).

In 1 non-gonorrhœal case recurrence occurred from no apparent cause 3 months after treatment was suspended.

It is of interest to note that in six instances sisters were affected at the same time, and in each instance a remarkable similarity in clinical course, bacteriological findings and response to therapy, was noted.

Direct contact (rape) was responsible for four of the gonorrhœal and one of the non-gonorrhœal cases.

According to Treumith the average course of vulvovaginitis is 4.5 months. By the method employed by us the general average of treated cases was 7 weeks, or less than one-half the usual duration. No complications were encountered in our series.

The gynecologist, because of his equipment for vaginal treatments, his familiarity with vaginal smears, and his appreciation of the significance of complete cure of vulvovaginitis is the logical specialist to treat this condition.

Those who accept the vulvovaginitis patients for treatment should agree upon etiology, mode of diagnosis, and principle of therapy, so that results can be properly interpreted. The accepted criteria of cure should be definite and the liability of recurrence emphasized.

CONCLUSIONS

1. Vulvovaginitis is an infection which frequently is gonorrhœal in origin, but may, even in purulent varieties, be non-specific. Filth, unquestionably, plays a part in predisposing to the infection and may be the chief cause in the milder types.

2. Diagnosis rests upon clinical evidence of the disease and smear examination made by an expert. Cultures prove positive in about 50 per cent of gonorrhœal cases and are therefore not requisite for diagnosis.

3. Purulent vulvovaginitis should be vigorously treated by an approved method, such as that suggested by Gellhorn. A daily tub bath is an aid to local treatment and in mild non-gonorrhœal cases, is all that is required for cure.

4. Determination of cure rests upon the disappearance of clinical evidence of the infection, three negative smears at intervals of 1 week after suspending treatment, and a period of observation equal in time to the duration of the treatment.

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METABOLISM READINGS IN EIGHTY-FOUR PREGNANT CASES[1]

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THIS work was begun in July, 1920. A Jones metabolimeter was used throughout the work, and the machine was tested at the factory on an average of every 4 months. All cases previous to April, 1921, were not used. It was felt that the work was too experimental then to justify any conclusions. Since April, 1921, 84 cases have been completed, that is to say, at least one reading was taken previous to delivery and one reading taken after delivery. It has been found that the work was pursued under extreme difficulty because of the failure on the part of pregnant women to take the tests seriously and to report previous to labor. Many cases were not completed for various reasons.

In reviewing the literature on basal metabolism in pregnancy and the puerperium very little was found. Apparently no effort has been made to determine whether the basal metabolic reading would show anything valuable in pregnancy. Baer's article which appeared in September, 1921,[2] is the first and only article which shows this work. His conclusions based on 44 normal cases in late pregnancy showed an average increase from 33 to 35 per cent above normal. Three days after delivery the average metabolic rate was 15 per cent above normal, while 7 to 10 days after delivery it was approximately normal. He also states that the death of the fœtus in late pregnancy was detected in women otherwise normal by a drop in the basal metabolic rate compared with the average in his series.

Magnus-Levy noted a rise of 17 per cent for pregnant women. Zuntz, Carpenter, Mueller, and Hasselbach noted an increase of 4 per cent.

Most of the work done in this series of 84 cases was on private patients. The cases are not consecutive because so many patients failed to report for readings. In most of the cases the reading was taken during the last month of pregnancy, the second reading after delivery being taken anywhere from the third to the sixteenth day postpartum.

In these 84 cases there were 54 normal cephalic deliveries; 2 breech deliveries with extractions; 1 high forceps; 8 mid-forceps; 6 low forceps; 1 craniotomy on a dead fœtus; 7 versions and extractions; and five cæsarean sections. There were 49 primiparæ and 35 multiparæ.

It will be noted from Table I that in pregnancy there is a gradual increase in the metabolic rate the older the patient. The average increase in the rate for all ages is practically 29. This compares favorably with the results reported by Baer. The average rate after delivery including all cases was +21.5. Here his results and mine vary. I am unable to show an average return to normal in 7 to 10 days. Even at the end of 10 to 16 days there was an increase in the rate. This seems logical. The mother has taken on new functions, that of supplying milk. Also the generative organs are undergoing involution. Both of these functions require a greater amount of energy, hence the metabolic rate should be increased. It has not been possible to prove this point because nursing women will not report back to have the metabolic test made. The results after delivery have been divided as shown in Table II.

In the first 3 days 1 patient returned to the average normal metabolic rate. Her read-

TABLE I. AVERAGE METABOLIC RATE

	Before	After
Under 20 years	26.75	10.00
Between 21 and 25	23.73	15.55
Between 26 and 30	28.23	19.62
Between 31 and 35	33.21	24.35
Between 35 and 40	33.00	28.50

TABLE II. METABOLISM RATE AFTER DELIVERY

	Rate
1 to 3 days after delivery	27.30
4 to 6 days after delivery	19.30
7 to 9 days after delivery	17.93
10 to 16 days after delivery	22.70

[2] Baer, J. L. Am. J. Obst. & Gynec., 1921, ii, 249

[1] Read before the Chicago Gynecological Society, June 16, 1922. (For discussion see p. 124.)

ing was +8. In the second 3 days 1 patient reached the absolute normal rate while 10 patients reached a rate of +8 or less, making a total of 11 patients who approximated the normal in 51 cases.

In the third series 1 patient returned to normal. Five patients out of 16 showed a metabolic rate of +8 or less. In the fourth series none of the readings was below +13 in 7 cases. In the entire series, therefore, 18 patients gave readings +8 or less or approximately 21.5 per cent.

In this series there were several patients who showed high blood pressure and other abnormal conditions. I will give briefly the obstetrical histories of these patients. Among the toxæmias of pregnancy were the following:

Case No. 108. Para-II, reported at the end of third month of pregnancy, at which time her blood pressure was normal as were the urinary findings. Everything went along smoothly in her pregnancy until the seventh month when she complained of marked œdema, with headache and constipation. This condition appeared within 2 days after she had been examined. On May 13 her blood pressure was 180–100. She was immediately sent to the hospital for observation. While in the hospital her blood pressure varied from day to day, never going below 150 systolic, in spite of diet and other treatment. The baby died *in utero* and was delivered on June 14. It was slightly macerated. The patient left the hospital on June 30 in fair condition.

This case is not included in the table. Because of the patient's hysterical condition we were unable to take the metabolic reading after delivery. The reading taken on May 23 showed a rate of +40.

Case No. 1230. Para-I. This was a high blood pressure case diagnosed as a "kidney of pregnancy." In the seventh month of pregnancy she developed marked increase in blood pressure with albumin and hyaline casts in the urine. She was given appropriate treatment but, in spite of this her blood pressure remained at an average of 160 systolic and 100 diastolic. On September 25, 1921, labor was induced, delivery finally taking place after 24 hours, occipito-lævo-posterior and mid-forceps. The metabolic reading on August 23 was +5; on September 29, 4 days after delivery, +18. She was discharged from the hospital with blood pressure of 130–100 and the urine practically clear.

Case No. 1274. Para-I. Reported in the seventh month of pregnancy with a blood pressure of 150–74. In spite of active treatment her blood pressure remained near this figure and on July 11 she complained of dizzy attacks and considerable œdema of the extremities and face. Induction of labor was started July 16. It ended spontaneously with occipito-lævo-anterior. The induction increased the blood pressure. The patient also had a polyhydramnios. Very little kidney disturbance was noted until the last 48 hours previous to delivery when albumin and casts were found in the urine. The metabolic reading taken on July 13 was +28; that taken on the 23d was +20. The patient was discharged from the hospital in good condition.

Case No. 1282. This patient gave a history of high blood pressure for 4 years previous to the beginning of pregnancy. Father and mother were both high blood pressure cases, the mother having a blood pressure of over 200 constantly. This patient had a considerable amount of work done throughout her pregnancy. She reported first at the fourth month, at which time the blood pressure was 143–80. Reading taken bimonthly until the latter part of October ranged between 138 and 150 systolic and 90 diastolic. In October she developed marked signs of a kidney of pregnancy. Her blood pressure was 180–100. Two metabolic readings were made on this patient, one on September 3 when it was +12 with a blood pressure reading of 130–85; the other on November 8, at which time the metabolic rate was +18 and blood pressure 204–140. The phenolphthalein test made on November 8, showed 5 per cent in the first hour and 30 per cent in the second hour. Blood chemistry taken on November 9 showed non-protein 46.1 milligrams per 100 cubic centimeters of blood.

This patient's baby died *in utero*. She went into spontaneous labor and after the cervix was dilated sufficiently craniotomy was done. The baby weighed 1000 grams and was macerated. At autopsy no pathological findings were noted and no growths were obtained from any of the organs. The metabolic rate 5 days after delivery was +10.

Case No. 1339. Para-III. Reported in the eighth month of pregnancy with a blood pressure of 150–80. She complained of roaring in her ears and marked œdema of the hands and legs. She entered the hospital on July 18 complaining of spots before her eyes, œdema of the hands, legs, and face. On the 19th her blood pressure was 160–78 and on the 20th, 174–100. In two previous pregnancies she aborted before 2½ months. She was exceedingly anxious for a living baby. She had a slightly contracted pelvis. Cæsarean section was done on July 20, from which she recovered nicely. The baby weighed 3240 grams. It developed a pyloric stenosis and was operated upon the tenth day, making a satisfactory recovery. The metabolic reading taken July 18 showed +8; 5 days after delivery it was +8.

Case No. 401. Para-II. This patient was a chronic nephritic with fibroids of the uterus. In her first pregnancy she developed eclampsia with a blood pressure of 224–120. Her sister died of eclampsia. The patient reported in the second month of

pregnancy, at which time her blood pressure was found to be increased. She returned every 2 weeks and the blood pressure charts showed a gradual increase. She was referred to Dr. Solomon Strouse who advised that the pregnancy be interrupted. On September 6, a hysterectomy was performed. At that time her blood pressure was 150–100 and she showed marked signs of chronic nephritis. The metabolic reading taken on September 2 was +8; taken again 6 days after operation, it was +25. This patient had no temperature rise throughout her convalescence.

Case No. 1190. Para-II. This case was one of toxæmia of pregnancy. The patient had had one miscarriage. She reported in the third month of her pregnancy and blood pressure readings were taken bimonthly. A chronic nephritis was found on the first examination, at which time the blood pressure was 160–73. It remained near this figure until October 21 (8½ months), when it rose to 188–98. Labor was induced October 21 with castor oil and quinine. She had a spontaneous delivery, right occipito-anterior. Metabolic reading taken on May 24, in the fourth month of pregnancy, showed +30. Taken again on September 27, it was +7. This was one of the patients in whom it was impossible to get a reading after delivery.

Case No. 1360. This patient was an elderly primipara who showed a normal blood pressure throughout her prenatal care. She was in labor 40 hours. She had a generally contracted, flat pelvis. The baby weighed 2800 grams and was delivered March 15 by low cervical cæsarean section. She developed a high temperature and on the ninth day a small amount of pus was discharged from the abdominal wound. The metabolic reading on March 1 was +49 and on March 31, 16 days after delivery, +36. This case is reported because of the high readings noted. These were undoubtedly due to the mild degree of temperature and the presence of infection.

Case No. 1337. Multipara. Reported in the seventh month of pregnancy. Nothing unusual was noted in her prenatal care. She went into labor spontaneously on December 18 and had a normal delivery left occipito-anterior. She developed a thrombophlebitis, the highest temperature being 99.6° F. On December 2 the metabolic reading was +6. On December 23, 4 days after delivery, it was +42. At that time she began to complain of pain in the leg. The increase in the metabolic rate was probably due to the infection.

One case in the series, No. 909, a multipara, reported in the second month of pregnancy. Throughout her prenatal care everything went along smoothly. She went into labor spontaneously and delivered, left occipito-anterior, after 7 hours. Her blood pressure was normal and the highest temperature 99.2° F. The metabolic reading on December 7 was −5. On December 25, 8 days after delivery, it was 0. Just why this patient should have shown such a peculiar metabolic rate is difficult to explain.

Two house cases were examined. Mrs. E. K. was sent in with a high blood pressure, 200–160. The metabolic reading, taken on January 16, 1922, showed +32. Labor was induced on the 17th and she delivered spontaneously left occipito-anterior, second metabolic test was made January 21, 4 days after delivery, with a rate of +10. Blood pressure on this day was 160–142. This patient made a splendid recovery. She and the baby left the hospital in good condition.

Mrs. F. K., primipara, entered the hospital with high blood pressure and pre-eclamptic symptoms. Labor was induced January 23 and twins delivered, the first one, left occipito-anterior, low forceps; and the second one, left sacro-anterior, with manual aid. She developed convulsions shortly before delivery was effected. Metabolic reading taken on January 16 with a blood pressure of 150–70.

Grouping these toxic cases we find the average metabolic reading before delivery is +21 and after delivery +14.5. The readings vary so in range that no reliable data can be deduced. In other words the metabolic reading gives no information regarding the degree of toxæmia. Just as marked a variation is seen in the normal case. Both cases in which infection was present showed a marked increase in metabolic rate after delivery. This does not add much to our knowledge, however.

Case No. 1268. Para-I. Reported in the third month of pregnancy, at which time it was noted that she had a chronic appendicitis but not severe enough to demand operation. Her prenatal care showed nothing unusual. Life was felt June 13, bringing delivery date to November 29. Her last period was February 26, bringing the delivery date to December 23; she did not go into labor. The patient was seen January 4, at which time the fœtal heart tones were normal and the child was not very large. On January 6 she was given castor oil and quinine and delivered spontaneously right occipito-anterior. The heart tones were noted throughout labor. At delivery it was found that the child's hands and feet were covered with large blebs. The heart was beating and the child made a feeble cry, but expired within 30 minutes. The metabolic reading taken on November 11 showed −1. Taken again on January 10, 4 days after delivery, it showed +7. Nothing was found on the autopsy to account for this child's condition. The maternal family history was negative.

Case No. 1295. Para-I. This patient was first seen in the sixth month of pregnancy, with a negative history. Wassermann was negative. Two weeks after her first appearance a near relative suddenly died and 2 days later the patient stated that she did not feel the baby. The author being

TABLE III.—METABOLISM TESTS IN PREGNANCY

Name		Age	Para	Blood pressure	Period tested	Rate	Remarks
SB.	Before	16	I	[illegible]	7th mo.	+12	
	After			80-70-60	8th day	+25	
CT.	Before	25	I	[illegible]	9th mo.	+15	
	After			110-88-70	3rd day	+20	
CA.	Before	2	II	110-75-65	9th mo.	+10	
	After			100-85-70	5th day	+26	
DE.	Before	20	III	105-60	9th mo.	+15	
	After			100-90-74	6th day	+20	
PL.	Before	26	I	100-80-60	9th mo.	+20	
	After			98-80-70	5th day	+ 4	
GF.	Before	25	II	115-80-60	9th mo.	+20	
	After			110-90-76	5th day	+10	
PE.	Before	24	I	118-95-86	9th mo.	+28	
	After			120-95-80	3rd day	+42	
KR.	Before	31	I	114-90	9th mo.	+50	
	After			100-80-76	5th day	+60	
LI.	Before	32	I	114-72	9th mo.	+28	
	After			110-90-72	3rd day	+15	
BT.	Before	30	III	120-108-80	9th mo.	+85	Very neurotic.
	After			110-85-70	4th day	+50	
BH.	Before	25	I	110-100-90	9th mo.	+38	
	After			105-85-70	6th day	+35	
GG.	Before	3	I	105-85-65	9th mo.	+50	Very neurotic.
	After			98-80-62	5th day	+ 8	
BR.	Before	26	I	108-80-65	9th mo.	+18	
	After			90-75-60	3rd day	+28	
HN.	Before	25	I	120-90-70	9th mo.	+88	
	After			110-85-70	4th day	+20	
KR.	Before	22	I	120-80-60	9th mo.	+50	
	After			110-85-70	12th day	+20	
LN.	Before	23	I	120-100-80	9th mo.	+22	
	After			110-85-50	5th day	+15	
WF.	Before	34	III	110-90-80	9th mo.	+22	
	After			107-92-80	6th day	+27	
MH.	Before	30	IV	110-94-88	9th mo.	+22	
	After			102-80-64	5th day	+36	
GN.	Before	35	II	110-90-82	9th mo.	+15	
	After			100-90-70	8th day	+20	
SA.	Before	31	IV	112-90-70	9th mo.	+25	
	After			102-86-68	7th day	+26	
CV.	Before	27	III	100-84-62	9th mo.	+17	
	After			98-80-72	1st day	+20	
KS.	Before	[illegible]	I	[illegible]	9th mo.	+20	
	After			[illegible]	4th day	+1	Cæsarean.

Name		Age	Para	Blood pressure	Period tested	Rate	Remarks
GE.	Before	43	II	108-90-78	9th mo.	−78	
	After			100-90-76	5th day	+18	
JS.	Before	23	IV	105-90-80	9th mo.	+35	Twins.
	After			125-104-90	7th day	+30	
GZ.	Before	21	I	120-82-70	9th mo.	+20	
	After			110-88-70	6th day	+20	
MN.	Before	23	II	138-100-86	9th mo.	+20	Twins.
	After			110-86-70	6th day	+ 5	
RL.	Before	36	IV	138-120-98	9th mo.	+ 5	
	After			120-108-90	6th day		
KL.	Before	2	I	120-102-94	9th mo.		
	After			110-[illegible]	[illegible]		
FN.	Before	27	I	118-92-80	9th mo.	+28	
	After			118-[illegible]	5th day	+20	
ZW.	Before	24	I	98-72-50	9th mo.	+22	
	After			98-72-50	5th day	+20	
KZ.	Before	29	I	122-112-98	9th mo.	+18	
	After			110-90-80		+18	
MN.	Before	31	I	120-[illegible]	9th mo.	+20	
	After			110-[illegible]	7th day	+12	
PD.	Before	24	I	125-[illegible]	9th mo.	+20	
	After			[illegible]	5th day	+12	
NL.	Before	2	III	[illegible]	9th mo.	+40	Goiter and mitral; regurgitation.
	After			90-75-54	5th day	+15	
TE.	Before	27	II	104-80-70	9th mo.	+15	
	After			108-86-70	[illegible]	+18	
FS.	Before	26	I	90-70-50	9th mo.	+28	
	After			[illegible]	3rd day	+27	
SS.	Before	40	II	124-120-60	3rd mo.	+ 8	Chronic nephritis, fibroids; hysterectomy.
	After			136-118-70	6th day	[illegible]	
WI.	Before	24	I	[illegible]	[illegible]	[illegible]	
	After			[illegible]	6th day	+20	
KN.	Before	01	I	130-106-85	6th mo.	[illegible]	Interruption of pregnancy; macerated fetus.
	After			158-80-70	5th day	+10	
HR.	Before	6	I	122-90-68	[illegible]	—	
	After			110-80-72	[illegible]	+18	
PL.	Before	6	I	120-94-80	9th mo.	[illegible]	
	After			[illegible]	[illegible]	[illegible]	
LN.	Before	2	I	[illegible]	7th mo.	[illegible]	Twins dead at time metabolism tests made.
	After			100-80-60	8th day	+ 8	
HN.	Before	[illegible]	I	[illegible]	9th mo.	[illegible]	
	After			110-80-70	4th day	+ 8	
EN.	Before	[illegible]	I	114-90-80	9th mo.	[illegible]	
	After			124-[illegible]	3rd day	[illegible]	

TABLE III.—METABOLISM TESTS IN PREGNANCY—CONTINUED

Name		Age	Para	Blood pressure	Period tested	Rate	Remarks
BT.	Before	24	II	100-90-82	9th mo.	+10	
	After			98-80-56	13th day	+20	
KD.	Before	30	II	140-100-90	9th mo.	+20	
	After			142-125-90	4th day	+24	
KN.	Before	21	I	100-80-62	9th mo.	+33	
	After			102-70-68	12th day	+15	
HC.	Before	20	III	102-84-70	9th mo.	+13	
	After			118-90-80	5th day	+ 6	
MR.	Before	24	I	120-98-82	9th mo.	+20	
	After			110-90-80	4th day	+13	
SE.	Before	25	I	118-90-80	9th mo.	+35	
	After			100-80-70	5th day	+ 8	
HL.	Before	28	III	110-120-80	9th mo.	+ 8	Toxæmia of pregnancy, pre-eclamptic.
	After			140-120-80	5th day	+18	
HL.	Before	33	II	140-110-80	9th mo.	+50	
	After			130-108-90	6th day	+52	
PS.	Before	29	III	120-90-70	9th mo.	+ 8	
	After			118-88-74	4th day	+ 7	
VN.	Before	29	II	112-90-80	9th mo.	+15	
	After			108-80-70	6th day	+11	
OK.	Before	23	I	108-80-60	9th mo.	- 1	
	After			112-80-74	5th day	+ 7	
EM.	Before	21	I	122-108-80	7½ mos.	+20	
	After			98-70-60	4th day	+10	
HJ.	Before	23	I	110-100-80	9th mo.	+ 31	
	After			100-80-70	4th day	0	
HN.	Before	23	I	120-100-80	9th mo.	+10	No after tests.
CR.	Before	23	I	120-90-74	9th mo.	+18	
	After			118-80-72	7th day	+ 6	
KN.	Before	34	I	140-95-80	9th mo.	+13	
	After			120-65-55	3rd day	+16	
SH.	Before	24	II	102-60-50	9th mo.	+ 6	
	After			112-86-70	6th day	+20	
LM.	Before	28	III	110-80-70	9th mo.	+ 8	No after tests.
BY.	Before	27	I	110-90-80	9th mo.	+18	
	After			118-85-72	5th day	+25	
KR.	Before	36	IV	118-80-70	9th mo.	+ 6	
	After			110-75-65	4th day	+42	
MS.	Before	25	II	135-80-70	9th mo.	- 5	
	After			118-80-70	8th day	0	
BD.	Before	29	III	98-70-60	9th mo.	+48	
	After			100-70-60	10th day	+20	

Name		Age	Para	Blood pressure	Period tested	Rate	Remarks
DR.	Before	28	I	120-82-70	9th mo.	+ 7	
	After			140-94-85	5th day	+18	
KY.	Before	28	V	200-180-160	8½ mos.	+32	Toxæmia of pregnancy; induction.
	After			160-140-110	4th day	+10	
HS.	Before	24	I	130-80-72	9th mo.	+16	
	After			120-85-75	3rd day	+ 5	
KH.	Before	30	I	188-140-80	9th mo.	+42	Induction eclampsia; twins.
	After			120-85-70		+11	
SH.	Before	31	I	116-80-75	9th mo.	+37	
	After			130-90-85	5th day	+10	
SO.	Before	17	I	105-92-58	9th mo.	+22	
	After			100-70-60	6th day	+28	
GT.	Before	32	II	110-98-82	9th mo.	+21	
	After			100-72-64	8th day	+20	
ZN.	Before	27	II	112-70-60	9th mo.	+47	
	After			112-70-62	9th day	+27	
MD.	Before	16	I	90-64-58	9th mo.	+18	
	After			90-62-50	4th day		
WN.	Before	20	I	110-64-56	9th mo.	+20	
	After			100-70-60	9th day	+22	
DW.	Before	31	I	122-80-72	9th mo.	+33	
	After			130-100-92	5th day	+ 8	
RN.	Before	34	II	118-80-72	9th mo.	+33	
	After			108-70-62	4th day	+14	
NR.	Before	35	II	112-70-60	9th mo.	+17	
	After			110-68-55	10th day	+13	
DN.	Before	28	II	108-78-60	9th mo.	- 5	
	After			100-70-62	7th day	+15	
CE.	Before	26	I	116-70-60	9th mo.	+47	"Cold."
	After			112-70-60	6th day	+31	
RG.	Before	37	I	120-90-82	9th mo.	+12	Cæsarean.
	After			124-88-76	10th day	+36	
FN.	Before	26	I	138-90-84	9th mo.	+70	
	After			134-114-88	5th day	+ 9	
BN.	Before	36	II	100-74-64	9th mo.	+44	
	After				6th day	+42	
LE.	Before	18	II	110-64-56	9th mo.	+55	
	After			114-78-70	6th day	+49	
TG.	Before	26	I	142-112-90	9th mo.	+60	
	After			116-90-74	10th day	+35	
BS.	Before	25	I	128-80-76	9th mo.	+45	
	After				6th day	+20	

away on vacation she was examined by two physicians who declared the child was dead. As near as we could figure the child died about July 9. Her last menstrual period was December 10. Frequent examinations were made between July 21 and October 2, the date this patient went into spontaneous labor. At no time in this interval were heart tones noted. The child was markedly macerated and showed all the signs of having been dead for a considerable period. It was thought that the metabolic reading might throw some light on the subject of whether the child was dead or not. The reading taken on September 7, 2 months after the child had died, showed +35. Taken again October 10, 8 days after delivery, showed +8.

One patient, Mrs. J. N., had a large thyroid. The metabolic reading taken 2 days before delivery showed +40. Taken 5 days after delivery, showed +15.

One patient in the series was a luetic. The metabolic reading taken 1 month before delivery showed +20 and 6 days after delivery showed +20.

Baer reports a case in which the diagnosis of macerated fœtus was made in the thirty-sixth week. This patient's reading was +10 before delivery and +8 after delivery. A similar case in my series varies little from the average pregnant case, hence I am unable to agree with Baer's statement that the death of the fœtus in late pregnancy in a woman otherwise normal is detected by a drop in the metabolic rate.

CONCLUSIONS

From the findings in this series of cases the following conclusions may be reached:

1. There is an increase in the metabolic rate above normal in pregnant women. It has a wide variation, however. There is nothing approaching a constant.

2. The test is subject to many errors beyond the control of the technician. The mental attitude of pregnant women is not stable, therefore the readings are not always reliable. Many tests in the experiment were not included in the report because of the hysterical condition of the patient at one or both tests.

3. The results in toxic cases were so variable that no reliable information was obtained. We could lay down no rule to guide us in determining the degree of toxicity or recovery in a given case. Neither could we say from the reading that labor should or should not be induced.

4. The death of the fœtus cannot be predicted from the metabolic rate.

5. The test consumes considerable time, effort, expense, and patience far out of proportion to the value of the information obtained.

RECURRENCE OF THE BENIGN PROSTATE[1]

By W. A. BRYAN, M.D., F.A.C.S., Nashville, Tennessee

THE word "recurrence" is employed here with the same significance given to it when applied to malignant tumors and with full conviction that it is a misnomer in both instances. The word carries the idea of complete cessation or disappearance or removal, and in neither instance is this true. In malignancy recurrence signifies that the tumor is not entirely destroyed or removed, and that the unharmed vestiges continue their growth until the tumor mass reappears. It is the same with recurrent prostates. No tumor or prostate can recur after all the cellular structures of their respective masses have been destroyed. This is another way of saying that recurrence of either of these pathological conditions is unmistakable proof of their incomplete removal.

The word "benign" is employed to signify the clinically and microscopically benign prostate, excluding all hypertrophied prostates which show microscopic evidences of carcinoma in varying ratio the maximum of which is 14 per cent. There is too great a discrepancy between this maximum figure and the clinical course of prostates, operated upon and not operated upon, for the surgeon to accept it as having valuable practical significance. Still, if there is microscopic evidence of malignancy, the recurrence might be accounted for on this score. Hence the establishment of benign recurrence must rest upon unquestionable cases. If these so-called malignant prostates can be cured by prostatectomy, it would not be unreasonable to admit their recurrence just as that of benign growths, or, if one prefers, as growths showing the same inoffensive type of malignancy found in the original tumor, if indeed we are to admit that benign recurrence can take place.

Hypertrophy of the prostate is due to an overgrowth of connective tissue or of the glandular tissue or to an admixture of these two elements. The latter is the mixed form described by Kaufmann, and the enlargement of the gland may be universal or occupy only certain portions. This may be the right lobe or the left or middle lobe or any two of them. When the hypertrophy is of the glandular or the mixed type, numerous centers of growth of individual nodules may be found, and numerous masses of varying size, from a guinea hen's egg down to the limit of unaided vision. This can be easily demonstrated by the simple gross examination of a few removed prostates, and is occasionally an annoying feature of prostatectomy, necessitating the removal of the gland piecemeal. It readily appears therefore how easily one or more such smaller masses may be left *in situ* at operation. The investigation by Tandler and Zuckerkandl of this subject is of great interest, especially when we reflect upon the cocksureness with which we have led ourselves to believe that we were doing complete prostatectomies. These men have studied cases on whom "complete" prostatectomy had been done and concluded that no complete prostatectomy was ever done, claiming that the "capsule" which operators so religiously refrain from disturbing is not a capsule from the anatomical or histological point of view, but is the prostate gland itself, or the remaining structurally normal portion of it which has been distended and compressed by the pathological masses growing within it. Unless this work can be proven entirely untrustworthy, the wonder is that more recurrences are not discovered.

Etiology is of value in this connection and undoubtedly has direct bearing on the recurrence. If the cause, whatever it may be, acts once and ceases to produce stimulative influence on the growth when it has acted, there should be no continuation of growth of unremoved fragments after prostatectomy. If the cause is continuous or repeated, it may produce a hypertrophy in unremoved portions which have been left by the surgeon. Or if the cause acts unequally on the lobes, the stimulus on the less advanced lobes may con-

[1] Read before the Southern Surgical Association, December, 1921.

tinue to act after removal of the portions of the gland which had advanced far enough to produce symptoms. No doubt this enlargement of lesser remaining lobes may continue at a greater rate than had been possible before removal of the larger adjacent masses.

The failure of more numerous reports of recurrence rests, I believe, upon two causes:

First, that the patient who has had his prostate removed by a surgeon and has been relieved of his symptoms and later finds those same symptoms returning has a question raised in his mind as to the genuineness of the removal of the gland. He finally is compelled to consult his physician, who examines him and tells him that his prostate has never been removed, because it is still there, palpable and producing symptoms. This physician may be entirely honest; probably only a small percentage of the profession know of the fact of recurrence. The patient naturally feels unkindly toward the surgeon who claims to have removed a gland which is still present at its original site.

Second, that, when compulsion drives him, this patient is likely to seek relief at other hands. The second surgeon probably is human and feels perhaps that he is about the only man in the world capable of doing a prostatectomy. He also may prove uncharitable and think that the first operator removed only a portion of the gland, and concludes that the recurrence is simply the continued growth of gross portions left through ignorance or neglect.

The treatment of such cases by two men consecutively robs both of them of the possibility of arriving at the truth, because neither is in position to compare the facts in his possession with the facts in the possession of the other. It is only when the primary condition and the recurrence are treated by the same man that the truth can be reached.

I have seen three cases of recurrence. One of these had been operated on by another surgeon, and came to me some years afterward on account of symptoms indicating recurrence. This was early in my career, and, not knowing the truth about such cases, I assured him most sanguinely that his prostate had not been removed. This case is no proof of recurrence. Perhaps my statement that it had not been removed was correct.

The second case was a recurrence of symptoms 2 years after the patient had been operated on by a most competent member of this association, whose death occurred prior to the second operation. I do not believe he would have done an incomplete prostatectomy, knowingly, still he might have left the right lobe on account of its small size, or might have overlooked it. I removed it. It was benign. This case does not prove anything.

The third case, I operated upon myself, removing the right and left lobes and the intermediate lobe. Microscopic examination proved it to be benign. This operation was done in November, 1915, and was what I considered to be a complete prostatectomy. The patient made a satisfactory recovery, and was relieved of his prostatic symptoms. He moved to another city, and began to develop obstructive symptoms again 2 years ago. Another surgeon was consulted and the patient was informed that prostatic hypertrophy and stones were the cause of his distress. The stones were removed in April, 1920. At the end of the year 1920 his trouble returned, and the same surgeon operated again in January, 1921, finding that the passage was blocked by the continued enlargement of the prostate. He assured the patient and his wife that there was absolutely no gross evidence of cancer. This surgeon was probably correct in refusing to do a radical operation on account of a bad heart and high blood pressure, contenting himself with permanent suprapubic drainage. Some months ago the patient returned to Nashville. He presents evidence of a uniform enlargement of the prostate just as if it had never been removed. The mass is easily as large as a tangerine, and bears no clinical evidence of malignancy. The general condition of the man is good. His appearance and nutrition are good. He is annoyed by continued stone formation and by his cardiac symptoms. He does not give the impression of a cancer patient. This case, too, is not to be accepted as absolute proof that the recurrence is benign, but much more serious conclusions have been based on far less convincing circumstantial evidence.

It was admitted in the beginning of this discussion that there is no such thing as true recurrence of a removed pathological tissue, and that recurrence in tumor or prostate is conclusive proof that some of the original tissues had escaped and subsequently grown to cognizable proportions.

While it may be agreed that it is culpable to leave gross portions of a prostate, it must be admitted that there is weighty evidence that "complete" prostatectomies are not complete, and that there is unequivocal proof that benign recurrences have followed prostatectomy at the hands of very able men. The possibility of such an outcome imposes upon the surgeon the necessity of a little more thoroughness in this work, not with the hope of escaping recurrence altogether, but with the hope of cutting the percentage of recurrences to a minimum.

NECESSITY FOR CAUTION IN THE EMPLOYMENT OF HIGH VOLTAGE ROENTGEN-RAYS AS A THERAPEUTIC AGENT AGAINST MALIGNANT DISEASE: ACUTE ADRENAL INSUFFICIENCY AND DEATH AS SEQUELÆ

By FRANK SMITHIES, M.D., F.A.C.P., Chicago
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MANY physicians whose training and experience in the theory or the practical application of principles involved in therapeutic actinology has been most meager, are treating patients affected with malignancy by roentgen-rays developed by a modified Coolidge tube, subjected to an electric current of from 200,000 to the neighborhood of 300,000 volts. The prevalent enthusiasm for this type of attack upon neoplasmata, while laudable, is apt to lead clinicians astray, unless unusual care is exercised in the correct application of the technical principles of the procedure, and unbiased scrutiny of end-results is the rule. Not sufficient work has been carried forward concerning the effects of high voltage currents upon normal tissue to enable one to prognose what will happen when malignant cells of themselves or in normal tissue are exposed to such currents. Such researches should be conducted by properly supervised and disinterested institutions before extravagant therapeutic claims are made by actinologists.

Medical literature has carried very few, if any, criticisms upon or warnings against the "new roentgen therapy." Occasionally, amid the mass of reports relative to the effects of high voltage currents upon tumors, one detects a mild questioning of end-results, or a caution regarding post-treatment "reactions" (shock, anuria, psychic disturbances, anæmia, anorexia, accelerated tumor growth, early exitus, etc.). Chiefly, however, contributions are concerned with the gross effects of the therapy upon the neoplasm; they give scant attention to pathological changes in tissues apart from those in which tumors are situated or to the clinical phenomena observable in cancer hosts.

In the circumstances, it would seem opportune and proper to summarize a recently observed patient and to let the facts carry their own burden of warning. The details are given *seriatim* and at length in order to emphasize the nature of the affection and because this report is one of the early instances of "roentgen death" in the literature.

CASE REPORT

The patient, a prosperous Michigan furniture manufacturer, aged 58, was seen at his home in consultation with his family physician. Previous to his present ailment, he had been favored with an exceptionally sound constitution; he had never had an incapacitating illness, had been active, physically and mentally, in business, and more recently, in war relief work, and had been greatly admired for his "fitness" and youthful appearance.

The present illness dates back less than 5 months. While riding a favorite horse, he was thrown, not

violently; he came down "flat on his back." He was not particularly shaken up, but experienced a soreness of the back muscles, and was a bit bruised generally. After a few days, since the soreness persisted, he was persuaded to visit a roentgenologist of repute in a neighboring city for the purpose of getting some films of his spine; it was thought that possibly there had been a slight twist or partial dislocation. The films revealed a considerable degree of lipping of the vertebræ, thickening of the periosteum, but no fractures or dislocations; there was an indefinite degree of tenderness accompanied by a possible limitation of movement in the lower thoracic and upper lumbar sections of the spines. Inasmuch as in these areas, the vertebræ seemed somewhat mottled and irregular and the intervertebral discs less definite than normal, the opinion was given that there existed an early osteosarcoma. Roentgen therapy, with voltage in the neighborhood of 230,000, was advised and the suggestion accepted.

Three séances, lasting "several hours, at least," were given. So far as could be ascertained, one treatment was given, through and through, from the back, directly over the supposedly sarcomatous area, and two "cross fire" treatments, from the back, at an angle of about 60 degrees to the spine. The patient then returned home. No immediate ill effects followed the roentgen séances.

Within a month following the roentgen therapy, the patient began to experience unusual fatigue upon slight exertion. Spinal pain and soreness had disappeared, but languor, palpitation of the heart, attacks of dizziness and distress "through the bowels" were present. It was thought that overwork was responsible for the disability, so a month's vacation was suggested and promptly taken. However, the disturbance became aggravated, and shortly, anorexia, attacks of exhausting diarrhœa, nausea, "nervousness," weight loss, and insomnia were noted.

A specialist in disorders of digestion was next consulted. He reported "achylia gastrica, pancreatic insufficiency and intestinal indigestion." Treatment to attempt relief was instituted and thoroughly carried out. There were no beneficial effects. Weakness, mental sluggishness, prostrating diarrhœa, weight loss, attacks of abdominal pain, and "nervous restlessness" became more distressing. About this time, the family physician noted a definite change in the patient's skin color; it was of a tan or yellowish-brown shade, diffuse in distribution; it resembled a mild icterus, but the sclera remained clear. Inasmuch as the man had been in the open for 2 months, the color change was considered, for the time being, "sun-burn." However, the attending physician kept the patient under observation. Within another month, the color had deepened to a uniform light, bronze-brown; the systolic blood pressure was 80 millimeters mercury; the urine contained albumin and granular casts, the red blood-cell count was between 2,000,000 and 2,500,000 per cubic millimeter, there was a leucopænia and the hæmoglobin was 55 per cent.

Shortly afterward, prostration, tachycardia, and diarrhœa confined the patient to his bed; a certain mental confusion developed; a weight loss in excess of 25 pounds over a period of 2 months was recorded; feeding was extremely difficult due to nausea and vomiting; malignancy was feared—possibly, metastases from the "sarcoma" of the spine; the skin had assumed a definite brownish hue; there was slight œdema about both ankles.

Rather more than a week before it was my privilege to see the patient, it was decided to take him for diagnostic study to a well known clinic. By this time he was so feeble that a wheel chair was required. Examination at this clinic disclosed no spinal anomaly whatever, no evidences of malignancy in any part of his body, gastric and pancreatic achylia, severe degree of "secondary" type of anæmia, and "Addison's disease" was suspected. The patient returned to his home, and within a few days sank into coma.

My findings were as follows (1 a.m.): A much emaciated middle aged man, in restless, somewhat stertorous coma; pulse 156, respiration 38, temperature 101° F. The skin was dry, wrinkled and was an intense bronze-brown shade with a peculiar ash gray hue when looked at from an angle; the navel zone, the genitalia, and the axillæ were the color of ebony lightly dusted over with the ash of a good cigar. In but three zones was the skin light in color: posteriorly, from the eighth thoracic spine to the mid-lumbar spine, and on each side, from the scapular tips to the iliac crests, were three overlapping, roughly circular areas, well defined, and of a pale tan-yellow color. In these zones, the skin was tough, wrinkle-free, shiny and seemed somewhat shallowly pitted. These areas represented the region which had been subjected to roentgen therapy; they had been "burned," scars had formed, and in these scarred places—as is characteristic for "Addison's disease"—excessive deposition of pigment, as exhibited generally by this man's skin, had not occurred. Pigment changes were noticeably present on the hard and soft palates and the buccal mucous membrane.

Soft œdema extended in slight degree from the malleoli half way to the knees. Knee, elbow, cremasteric, plantar, and Oppenheim responses were absent or very sluggish. There was no Kernig's sign; the lax rectal sphincter permitted a constant dripping of fluid, somewhat frothy, but blood and pus-free, fæces. There had been no urinary incontinence; the kidney output was greatly reduced.

Pupils were equally dilated and but sluggishly responsive to light exhibition; the eye grounds were very pale and œdematous, the blood vessels and disc being barely delimitable. Pharyngeal reflex was present. There were no gland enlargements.

The lungs were clear except for a few persistent, fine, moist râles over both lower lobes.

The heart was in moderate dilatation, generally; the sounds were weak but regular; a soft, blowing,

systolic bruit was audible throughout the entire precordia. The radial pulse was barely detectable, but when felt was soft and small; the arteries exhibited but slight stiffening. The systolic pressure was 42, the diastolic 34 (3 separate readings, by auscultation). The pressure exhibited no recognizable differences when noted at left and right radials.

There was striking general abdominal distention—the marked contrast of a "full" belly in a patient otherwise but a skin-covered skeleton. The distention was seemingly an ileus of large and small guts and the stomach; the wall was soft, atonic, and returned a peculiar "doughy" feel. There was no demonstrable free peritoneal fluid; the bowel distension practically obliterated liver and spleen outlines. Neither kidney could be palpated and there was demonstrated no local tenderness or abnormal kidney outlines. Local, right upper quadrant and epigastric palpation returned negative information

The spinal column was everywhere in normal alignment and over no area were there limitation of motion, abnormalities in contour, local tenderness, or other evidences of disease.

Rectal examination demonstrated no anomaly other than tremendous ileus of the rectum and sigmoid.

The hæmoglobin was 35 per cent; the red cell count not obtainable; the stained blood smear exhibited 42 per cent of lymphocytes and 56 per cent polynuclears; there were poikilocytosis, anisocytosis, polychromatophilia and deficient platelets; no erythroblasts were seen.

The urine was smoky brown and contained blood-derived pigment, albumin, and a few fine granular casts.

Epicrisis. Adrenalin and salt solution were given intravenously in heroic dose, the patient returned to partial consciousness and under such stimuli lived about 48 hours. Death ensued from exhaustion and cardiorenal failure.

RÉSUMÉ

Instances of "acute" or "fulminant" Addison's syndrome are rare; it is most unusual to have the disease appear after age 50 and *exitus* occur in less than a year. An instance of death from the Addisonian syndrome, within 4 months after "deep" roentgen therapy of long duration and very high voltage in a man aged 58 is recorded. The roentgen séances were given as curative measures for supposed malignancy of the spine (a diagnosis subsequently shown to have been faulty). It can scarcely be presumed that this patient's fall from his horse produced simultaneous acute, double-sided adrenal injury and failure. The man was very "fit" when he sustained what seemed to be nothing more than muscle bruises to his paraspinal group. He remained "fit," despite his slight muscular lameness, until a few weeks after roentgen exposures, and his collapse afterward was rapid.

The proximity of the adrenals to the areas treated by the high voltage X-rays for long time-intervals strongly suggests that this form of therapeusis was an agent responsible for the acute collapse of adrenal function and doubtless the destruction of chromaffin tissue. Unfortunately, autopsy was denied: the cause of the disability and death were, however, unmistakable.

NOTE.—It was through Dr. J. E. Meengs, of Grand Rapids, that I had opportunity of examining this patient.

RADIUM TREATMENT OF KELOIDS

BY ERNEST M. DALAND, M.D., BOSTON
From the Collis P. Huntington Memorial Hospital

A KELOID (cheloid) is an overgrowth of hyaline connective tissue in the skin or in a mass of scar tissue, with a complete destruction of the elastic fibers. Mallory (1) describes the microscopical appearance. "The fibroblasts of which they are composed are distributed in thin sheets between thick layers of collagen fibrils, which are more or less fused together and usually appear hyaline. The cells and fibrils run in various directions. The tissue resembles scar tissue."

Keloids usually develop as a result of trauma, but they may arise spontaneously. Clinically, a keloid appears as a tumor of the skin, but its color is decidedly pinker than normal skin, and it may even have a violet hue. It is raised and firm and usually has a

round, smooth crest. It is somewhat reduced in thickness by pressure, but does not entirely disappear. The keloidal tissue does not extend below the skin and is not deeply adherent. It may develop in scar tissue or around the periphery of the scar, tending to involve more and more of the scar as time goes on. Keloids never become malignant. Secondary changes and rapid growth are due to increased hyalinosis (2). Keloids were formerly considered to be of infectious or tuberculous origin.

Contrary to the usual idea, keloids cause besides cosmetic disfigurement considerable discomfort to the patient. The majority of patients seen in our clinic complained of pain, itching, or a "pulling sensation" in the growth.

Negroes are more susceptible to these lesions than others. However, in this series, this statement is not borne out. While it is said that in southern clinics the majority of patients presenting themselves for treatment are negroes, only two negroes were treated in our clinic. Thirty-three of the patients (57 per cent) were of American birth. The others were fairly evenly divided among the nationalities found in this locality. No one people seemed more susceptible, but we realize that our number of cases is too small to draw any conclusions as to racial susceptibility.

TABLE I.—NATIONALITY OF PATIENTS

	Cases
American	33
Italian	6
Russian	3
Armenian	2
Irish	2
Canadian	2
American negro	2
Belgian, Spanish, Syrian, Haitian, Cuban, Greek, each	1

Of the fifty-eight cases seen in the Huntington Hospital clinic, the exposed areas of the body were the most commonly affected. The lesions in more than one-half of the cases were on the neck or upper part of the chest. In women, that part of the chest above and between the breasts is a particularly common place for keloids to develop. However, keloids may appear anywhere on the cutaneous surfaces. The writer has seen several keloids in vaccination and laparotomy scars. Frequently they follow tuberculous glands which have been incised or which have ruptured spontaneously. In short, they may occur wherever there has been an operative wound or trauma to the skin. Wickham and Degrais (3) describe a very unusual case of keloid of the mucous membrane of the upper lip.

Thirty-six patients of the cases reviewed were females and twenty-two were males. From these figures females would seem to be more prone to develop keloids for males are certainly more exposed to trauma than females.

Keloids may occur at any age. In our series the majority was evenly divided between the second, third and fourth decades.

TABLE II.—AGE INCIDENCE

	Cases
0 to 10 years	5
10 to 20 years	12
20 to 30 years	13
30 to 40 years	13
40 to 50 years	8
50 to 60 years	5

It is a well-known fact that burns are the commonest form of trauma which produces keloids. Unfortunately, many of our records fail to state the type of burn, whether caused by fire, hot water, caustic, etc. Twenty-one cases were seen following burns. Operative scars were the next commonest cause. No particular type of operation predominated, although incisions on the neck or chest seemed to be the most likely to develop keloids. Eleven cases are classed as "spontaneous," as there was no known cause. Some of these were doubtless of acne origin, as frequently the patien stated that the lesion "began as a pimple."

TABLE III. CAUSATIVE AGENT

		Cases
Spontaneous (no known cause)		11
Lacerations		7
Operative scars		14
Incisions for sepsis	6	
Excisions (glands, wens, etc.)	8	
Burns		1
Hot water	1	
Fire	1	
Caustic	1	
Hot water bottle	1	
Radiator	1	
Antipyretic	1	
Unspecified	10	
Tuberculous gland sinus		1
Acne vulgaris		1
No record		3

More than one-half of the cases were of less than 2 years' duration. Seven had existed for from 10 to 25 years.

TABLE IV.—DURATION OF KELOID

	Cases
1 year or less	20
1 to 2 years	12
3 years	4
4 years	2
5 years	4
5 to 10 years	11
10 to 15 years	1
15 to 20 years	2
20 to 25 years	1
Unknown	1

Twenty-two patients had been under treatment before appearing at our clinic. Operation was the chief means of treatment and several patients had been operated upon more than once. Five had received numerous X-ray treatments without improvement. One patient had been treated with radium without benefit. None had benefited from any form of treatment.

TABLE V.—PREVIOUS TREATMENT

	Cases
1 operative removal	14
2 operative removals	3
3 operative removals	1
X-ray	5
Freezing	1
Plaster	1
Acid	1
Ointment	2
Electricity	2
Radium	1
Excision and Thiersch Graft	1
Total	22

The tendency to develop keloids is frequently inherited. In one family there was a history of keloids in the patient's mother, brother, and sister. In another, a brother and a sister of the patient were said to have lesions of this type. Some people are very apt to develop a keloid every time their skin is traumatized, lacerated, or incised.

THE SEARCH FOR A SPECIFIC CURE FOR KELOIDS

Many types of therapy have been tried in the attempt to find a cure for keloidal growths. Excision has been attempted frequently, nearly always with the result that the growth recurred over a much larger area. Some operators have claimed that, if a keloid is removed without cutting into it, as if it were a malignant growth, it will not recur. Results do not verify this conclusion, however, and the method has been practically abandoned.

Smyth (4) reported a case of keloid of the ear, cured by the injection of formalin. Lesieur (5) injected oil of creosote, made by dissolving 10 grams of creosote in 150 grams of sterile olive oil. This resulted in a disappearance of the rose tint of the tumor and served to arrest growing keloids. A regrowth of the keloid never took place at the site of the needle point. Electrolysis with the galvanic current reduces the size of the growth and decreases the amount of pain, but does not entirely destroy the lesion. Ahlswede (6) used pepsin-hydrochloric acid to digest the collagenous tissue. He does not mention his results. Carbon dioxide snow has been used successfully in a few cases. Gougerot (7) injected an aqueous solution of fibrolysin subcutaneously. This was repeated every 2 days for 20 to 30 days. Some of his results were good. Vidal (8) has shown that deep scarifications performed repeatedly will produce good results. These treatments must be kept up for months and even years. Tousey (9) used thiosinamin, either in capsules or subcutaneously. He reported absorption of the keloids, together with a loss of the tendency to develop these lesions.

A new chapter in the treatment of these lesions was opened up with the appearance of light therapy. The first type used was the Finsen ray, which proved fairly effective in reducing the size of some keloids. It is painless and involves no ulceration, according to Gaucher (10).

The X-ray was still more of an advance. In skilled hands, with repeated treatments, many cases are cured. There are others which are very resistant. Knox (11), Gougerot (7) and Pfahler (12) describe the technique used. Lopez-Silvero (13) and others advise excision of the keloid, followed by X-ray treatment.

Radium has proved to be the best therapeutical agent thus far found. Wickham and Degrais did the first work along this line. They noted that radium has a specific action

TABLE VI. TREATMENT ADVISED

	Cases
No. cases examined	58
Radium advised	54
Radium advised and given	48
Radium advised and not given	6
Radium not advised	4
Radium advised after excision but not given	1
Radium following excision at another hospital	1

on some keloids, destroying them by absorption. They reported a large number of cases without a single recurrence. It was the publication of these results that led us to start our series.

TREATMENT ADVISED IN OUR SERIES

Fifty-eight cases were seen at the Huntington Hospital during the period from January, 1914, to July, 1921. Radium treatment was advised in 54 cases. One patient had a keloid on his foot, with an extensive ulcer nearby. It was thought that treatment of the ulcer was more important than radiation of the keloid. In another case the keloid was very soft, and as it was of very recent origin, radium was not advised. The lesion subsequently disappeared without treatment. Excision, followed by radiation, was advised in one case, but the patient failed to return for radiation until the lesion had recurred. It was then successfully radiated. Excision in another case was done at another hospital with the intention of referring him back to us for radium. This patient died of scarlet fever following the operation. Six patients failed to return for radium after it was advised. Forty-eight were treated by radium alone.

Excision of a large keloid of the chin and neck, followed by a Thiersch graft, was done by a member of our staff at another hospital. The patient was immediately referred to us for a keloid developing around the periphery. This was destroyed after several treatments and has not recurred.

METHODS OF TREATMENT

Many different methods of treatment have been tried in the radiation of these lesions. Early in the series we were handicapped by having but a small amount of radium. Some of the early cases were treated with glass emanation tubes in 0.25 millimeter steel jackets and with 2 millimeters lead screening. In others the screening was 1 centimeter gauze, 1 centimeter air or 1 millimeter lead. In the two cases classed as "unsatisfactory" (Table VII) the screening used was 2 millimeters lead.

It has been interesting to note a fairly definite proportion between the age of a keloid and the amount of radiation required to eradicate it. It has also been noticeable that keloids in children respond more easily to treatment than do those in adults. The earliest case seen was the following.

Case 1. M. B., 10 years, of American parentage, entered the hospital for the removal of a large congenital verruca of the neck. Excision was done on April 27, 1921. Convalescence was uneventful. On June 24, a beginning keloid was noticed along the entire scar. Radium treatments on June 24 and July 22 entirely destroyed the keloid. On the first date two emanation tubes of 35 millicuries each with 0.25 millimeter steel and 1 millimeter silver filtration were placed longitudinally and end-to-end on the keloid and allowed to remain 1 hour. This gave a dosage for each tube of 35 millicurie hours. On the second date a similar treatment was given over a different portion of the scar. The dosage on this occasion was 40 millicurie hours for each tube. Slight erythema developed from each treatment, but there was no ulceration. There was no recurrence at the end of 6 months. This same patient had a congenital verruca of her ear. This was treated with destructive doses of radium and has been nearly destroyed. Even with destructive, ulcerating doses, there has been no tendency to form keloids in the scar of the ear.

Another case treated entirely with silver filtration (γ radiation) follows:

Case 2. H. M., 4 years, of American parentage, burned her neck with boiling water 7 months before admission to the hospital. An extensive scar formed, with secondary keloid. Four months later an operation was performed at another hospital for the purpose of loosening up the scar. Keloidal tissue immediately formed all over the scar, increasing the contracture. She was treated eight times with the same type of filtration described in Case 1. One or two tubes were used each time, with an average dosage of 44 millicurie hours. At the end of 9 months the keloid was destroyed and the scar white. The underlying scar tissue was softened, making the contracture scarcely noticeable.

The case illustrates the close relationship between scar tissue and keloid. Scar tissue may be softened by radiation, but it does not

respond to radiation as well as does pure keloid tissue. In some cases it is difficult to determine whether one is dealing entirely with scar or whether there is a keloidal element present.

We have found that it is usually necessary to use less filtration than that used in the two cases reported. Patients who have had keloids for several years require β-radiation in addition to γ. β-radiation produces an ulceration and destroys the pigment layer of the skin, already badly damaged. This results in a white scar which eventually becomes somewhat pink, but it never returns to the color of normal skin. In people with dark skin this makes a very noticeable scar. However, we have found that most of the patients would rather have an ulcerative treatment, and thus secure quicker results, than to have the silver filtration. It must be explained in advance that there will be some local discomfort if this type of treatment is given. The majority of our adult cases have been treated with the steel-jacketed tubes, either laid directly on the lesion or raised on 2 to 5 millimeters of gauze. The average dose per tube has been 15 millicurie hours, and the average number of treatments, six. No two cases require exactly the same dosage. In some, 10 millicurie hours produced very little reaction, while in others, 30 millicurie hours produced but slight redness. Occasionally 0.5 millimeter silver has been used where the unfiltered tube has caused excessive reaction in previous applications.

Case 3. C. B., 25 years, an American school teacher with multiple keloids on her shoulders, chest, and back was referred to me by Dr. C. J. White. The condition began as acne vulgaris and had been present 10 years. On May 7, 1921, she received a treatment of 92 millicurie hours with 0.25 millimeter steel, 0.5 millimeter silver and 1 centimeter gauze filtration over one area. There was no result. On June 3, a dosage of 63 millicurie hours was given over the same area with no result. On July 9, a dosage of 60 millicurie hours was given with 0.25 millimeters steel and 1 centimeter gauze filtration but no silver. There was slight softening but no erythema. A dosage of 30 millicurie hours more was given on July 20 and slight ulceration resulted. Another area was treated at intervals of about one month with 50 millicurie hours and 72 millicurie hours (0.25 millimeters steel, 0.5 millimeters silver and 0.5 centimeters gauze), without result. Three weeks later 65 millicurie hours without screening produced a deep ulceration. A third area was treated with 38 millicurie hours (unscreened) and resulted in erythema and ulceration. Other areas were then treated without filtration. It was found that the same dosage caused ulceration in some lesions and had no effect on others. This case is still under treatment. All the ulcers have healed, leaving flat, smooth scars, free from pain.

TABLE VII. RESULTS OF RADIUM TREATMENT

	Cases
Cases treated	48
Cases still under treatment	10
Keloid destroyed	26
Insufficient number of treatments	5
Greater amount of keloid destroyed	4
Original keloid destroyed but new one appearing nearby	2
Some keloids destroyed, others untreated	1
Unsatisfactory	2
Recurrences	6

RADIUM TREATMENT IN OTHER CLINICS

The problem whether to treat a given keloid by absorption doses or destructive doses has been a difficult one. Wickham and Degrais recognize the need of two types of treatment. They use frequent treatments of short duration in the early lesions or those in children and expect to cause a slight inflammatory reaction. In the old keloids in adults they use some unscreened tubes to effect a destructive action and others heavily screened to produce a "selective action."

Simpson (14) uses "selective" doses in children and gets a slight inflammatory reaction. In keloids mixed with scar tissue he uses destructive doses. Knox treats the entire keloid and the adjacent tissues to the point of superficial redness. Taft (15) has found that X-rays are effective but that radium is better. He avoids doses causing a reaction and covers his filter with rubber or chamois to avoid telangiectases. He believes that ulcerating doses are apt to cause a recurrence. Taussig (16) believes that all but the oldest keloids may be destroyed by radium.

Tousey advocates a dosage of 20 milligrams of radium salt, with a filter of 0.3 millimeters glass and 0.5 aluminum, for 20 minutes or more on each portion of the lesion. The applicators are covered with rubber. Pinch (17) of the London Radium Institute uses a "half strength" applicator, screened

with 1 millimeter silver. He makes three exposures of from 4 to 6 hours' duration on each of three successive days, then repeats the entire treatment every 2 months until the lesions have disappeared.

Jeanselme (8) advises radium treatment after deep scarification of the lesion. Pfahler reports good results by excision followed by either X-ray or radium. Rostaine (18) cites a case which recurred four times after excision but which did not recur after excision followed by radium therapy.

RESULTS

Ten of our forty-eight cases are still under treatment. Of the others, twenty-six have had a complete destruction of their lesions. Three patients ceased treatment before a sufficient number of applications had been made. Two cases were unsatisfactory, as the keloids, of long duration, were treated with too heavy filtration. There have been no recurrences, either in the cases treated by absorption doses or in those treated by actual destruction of the lesion. Two patients developed new keloids near the old ones.

Every case treated was benefited. The first evidence of relief was the development of a certain amount of anæsthesia in the lesion. Later there was a disappearance of the itching and pulling sensation. Finally there was a softening of the scar. There was less variation from the normal color of the skin in the cases treated with absorption doses. In a few of the cases treated with ulcerating doses telangiectasis followed, but this was by no means always true.

There was no evidence to show that the tendency of a given individual to develop these lesions was influenced by the treatment of any one lesion by radium.

CONCLUSIONS

1. It seems probable that every keloid can be destroyed by radium if a sufficient dose is used.

2. Silver filtration (1 millimeter) should be used in keloids of recent origin, in children, in people of dark complexion and in exposed areas, as the face. The dosage should be from 30 to 60 millicurie hours, according to the age of the patients.

3. Practically unfiltered tubes should be used on all other keloids. The dosage should be from 15 to 30 millicurie hours per tube. It should be explained to patient that ulceration will result from this type of treatment.

4. There is no evidence to show that the destructive doses damage the tissues so that the lesions recur. There is no lessening of the tendency of an individual to develop keloids.

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THE BLOOD SUPPLY OF THE THYROID GLAND AND ITS SURGICAL SIGNIFICANCE[1]

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In order to ascertain to what extent the blood supply of the thyroid gland is affected by ligations, it seemed advisable to study the various possible anastomoses. A detailed study of the blood supply was made by injecting the blood vessels of twenty-five necropsy specimens (after the method of Gross) with a barium-carmin-gelatin mixture, which was heated on a water bath to a temperature of about 60° C. The injections were made with a 10 cubic centimeter syringe under enough pressure to fill the capillaries. While the inferior thyroid artery was being injected, the solution ran out of the superior thyroid of the same side in all of the cases, out of the superior thyroid of the opposite side in 30 per cent of the cases, and out of the superior thyroids of both sides and the opposite inferior thyroid in 20 per cent. When the primary injection into the superior thyroid artery was made, the injected material could be seen in the inferior thyroid of the same side in all cases, in the superior thyroid of the opposite side in 80 per cent of the cases, and in all the vessels in 20 per cent of the cases. Various combinations of injections were used and roentgenograms were made after each injection. Later, the specimens were fixed in kaiserling and dissected. The best results were obtained by studying normal thyroids or small colloid goiters. The exophthalmic goiters were difficult to inject and the vessels did not show up well.

The principal arterial trunks ramified on the surface of the gland within the true capsule and anastomosed freely with one another. Anastomosis was freer between the various vessels of the same side than between those of opposite sides, although there was a well-marked branch of communication through the isthmus.

The larger arteries were distributed principally over the surface of the gland; there was only an occasional large vessel deep in the parenchyma. Each artery gave off several branches, some of which supplied the anterior surface of the gland and some the posterior. The main continuations of these arteries most commonly ran along and on the margins of the gland (Figs. 1 and 2).

The superior thyroid artery was more constant in division and distribution than the inferior thyroid artery. It generally divided into three branches. The largest branch ran downward over the anterior surface of the gland, sending branches in all directions; some of these ramified over the surface of the gland, some supplied the parenchyma of the gland, others anastomosed with the superior thyroid of the opposite side, and still others, with the inferior of the same side. The next largest branch descended along the posterior border of the gland and anastomosed with the inferior thyroid, sending branches to the parenchyma of the gland and to the trachea. Often a common trunk was formed by this anastomosis, and gave off a terminal artery which supplied the superior parathyroid body. The third branch entered the substance of the gland and with the other parenchymal branches, as shown by Major, rapidly divided and formed a network of vessels supplying the lobules (Fig. 3).

The inferior thyroid artery divided into two or more branches at varying distances from the gland. Latarjet and Alamartine report instances in which the division occurred quite close to the thyroid axis, and one case in which was a double inferior thyroid artery. Dwight reports an absence of the inferior thyroid artery on the right in one case and on the left in five cases in a series of 437. The principal branches of this artery entered the capsule of the gland on the posterior surface in the neighborhood of the middle third. A few of these branches ramified over the surface of the gland, while one large branch ran along the inferior border toward the isthmus. The number of branches and the points at which they enter the gland may vary considerably.

[1] Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery, April, 1922.

Fig. 1.

Fig. 1. Anterior view of a dissected thyroid gland injected with a carmin-gelatin-bismuth preparation showing: *a*, longitudinal anastomosis between inferior and superior thyroid arteries of the left side and *b*, complex anastomosis between both superior thyroid arteries and the inferior thyroid artery of the left side.

Fig. 2.

Fig. 2. Posterolateral view of a dissected thyroid injected with a carmin-gelatin-bismuth preparation. *a*, Blood vessel; *b*, recurrent laryngeal nerves; and *c*, parathyroids.

Fig. 3.

Fig. 3. Roentgenogram of normal thyroid after injection of all four thyroid vessels with a carmin-gelatin-bismuth preparation showing complex anastomosis at isthmus at *a*.

In the cases studied, the average point at which the principal branch of the inferior thyroid artery entered the capsule of the gland was 4.5 centimeters from the superior pole, and 1.8 centimeters from the inferior pole; the length of the lobe averaged 6.34 centimeters. In one case the uppermost branch entered the capsule 1 centimeter from the superior pole. In another case the lowest branch entered the capsule 0.25 centimeter from the inferior pole. The inferior thyroid artery was about one-third larger than the superior thyroid artery. The average inferior thyroid vessel measured 2.78 millimeters; the average superior thyroid artery measured 1.87 millimeters; the largest inferior was 3.68 millimeters; the smallest was 1.90 millimeters. The largest superior thyroid artery measured 2.38 millimeters, and the smallest 1.57 millimeters. In some instances definite arteries ran through the tracheal rings and entered the posterior surface of the gland; in others, branches from the inferior thyroid left the substance of the gland and entered the trachea on its anterolateral surface.

The microscopic blood vessels supplying the thyroid tissue were usually plentiful. The interlobular arteries, which are branches of the parenchymal vessels, were usually two to five in number and broke up into close networks that surrounded the follicles and lay immediately beneath the epithelium (Figs. 4, 5, 6, and 7).

Berard and Destol showed that the anastomoses were on the surface of the gland, and that few, if any, were intraglandular. Latarjet and Alamartine came to similar conclusions in their experiments. The most important anastomosis found in my experiments was the unilateral longitudinal anastomosis between the superior and inferior arteries of the same side. This anastomosis occurred on the lateral and posterior surfaces and occasionally just within the substance of the gland. Of these,

Fig. 4.

Fig. 5.

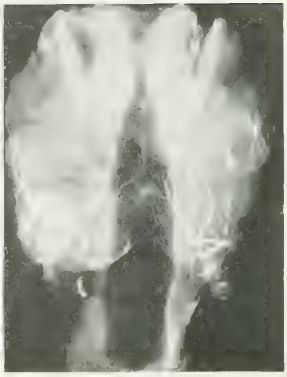

Fig. 6.

Fig. 4. Roentgenogram of right inferior thyroid artery injected with a carmin-gelatin-bismuth preparation.

Fig. 5. Roentgenogram of right inferior and right superior thyroid arteries injected with a carmin-gelatin-bismuth.

Fig. 6. Roentgenogram showing result of injection of the right superior thyroid artery and both inferior thyroid arteries with a carmin-gelatin-bismuth preparation.

the one on the lateral surface was seen most often. One of the branches that united the inferior and superior thyroid arteries most constantly lay in the angle formed by the trachea and œsophagus, and extended along the posterior border of the gland (Fig. 8).

The bilateral anastomoses were, as a rule, less developed, more complex, and extremely varied. Often there was direct communication between the superior thyroid vessels across the upper border of the isthmus, generally anteriorly, but at times posteriorly. Landstroem and Streckeisen have shown very clearly that such anastomoses are present on the surface of the gland, not only between the arteries of the same side, but also between those of opposite sides. Delore and Alamartine reached similar conclusions in a large series of injections. In this study no direct anastomosis was noted between the two inferior thyroid arteries (Fig. 9).

There was an indirect anastomosis by way of the larynx, trachea, and œsophagus, by which the blood supply to the thyroid gland could be re-established after ligation of all four arteries. The larynx was supplied by the superior laryngeal and cricothyroid arteries which are branches of the superior thyroid artery, and by the inferior laryngeal artery, a branch of the inferior thyroid. The trachea obtained its blood supply from branches of the inferior laryngeal and inferior thyroid arteries, which anastomosed below with bronchial arteries and with the internal mammary arteries through the anterior mediastinal twigs. Branches of inferior thyroid artery supplied œsophagus and anastomosed with lower branches of ascending pharyngeal artery (Fig. 10).

As a rule, the arteries in the substance of the thyroid gland were accompanied by two veins which were joined at various places by bar-like connections which crossed the arteries. The veins arose from the far side of the capillary network, followed the course of the arteries fairly closely, and anastomosed in a similar manner. They emptied at various places into the larger veins that emerged from the interior of the gland and anastomosed freely on the surface.

On examining the cut surface of injected glands it was observed that the individual vessels were larger in cases of colloid goiters than in cases of exophthalmic, and that the farther away from the capsule the sections were taken, the smaller the vessels. No one questions the vascularity of an active exoph-

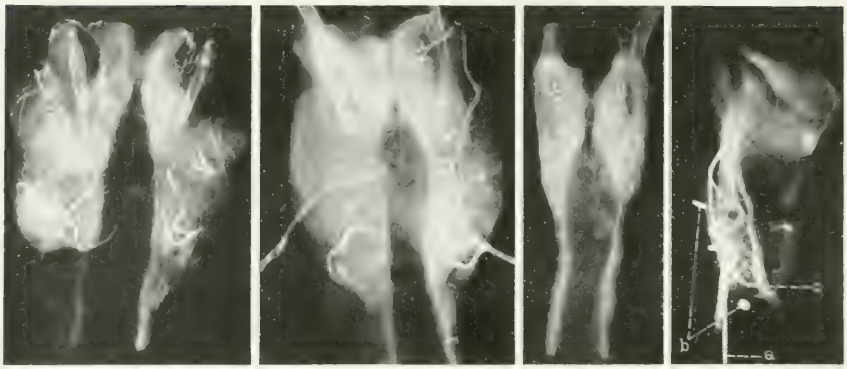

Fig. 7. Fig. 8. Fig. 9. Fig. 10.

Fig. 7. Result of injection of all four thyroid arteries.
Fig. 8. Result of injection of right inferior thyroid artery showing a very extensive anastomosis.
Fig. 9. Roentgenogram of trachea after all thyroid vessels had been injected with a carmin-gelatin-bismuth.

Fig. 10. Roentgenogram showing relation of: *a*, the recurrent laryngeal nerve and *b*, the parathyroids to *c*, the blood supply of the thyroid. Lateral view of a thyroid cut in two. Wire was laid along the nerve and metal tags were placed over the parathyroids.

thalmic goiter. This seeming contradiction is explained, therefore, by the fact that the lobules and follicles in the exophthalmic goiter are smaller but much more numerous within a given area and, as each has its individual blood supply, the vessels must, of necessity, break up into numerous smaller arterioles and capillaries in order to supply their lobules. In a colloid goiter the vessels in the parenchyma are larger and do not break down into so many minute capillaries as they do in exophthalmic goiter. The colloid is not distributed uniformly throughout the gland, but is in excess and under considerable pressure in various areas. The intralobular vessels are pressed on by this colloid to such extent that the lumina of the vessels are entirely obliterated, and the injected material is unable to penetrate them. This observation has been proved histologically by Wilson.

It is not understood just why patients with exophthalmic goiter are benefited by ligation of the superior thyroid arteries. If ligation should completely exclude the blood from the area supplied by the ligated vessel, necrosis would result. We know that it does not, for experiments show that the anastomosis is so rich that circulation can be re-established in a short time. Recently, thyroidectomy was performed at the Mayo Clinic about 2 weeks after all four vessels had been ligated, and little or no difference was noted in the vascularity of the gland (Figs. 11 and 12).

It would appear that some factor other than the blood supply must be responsible for the improvement after ligation. In experiments by Cannon, Binger, and Fitz, unmistakable signs of hyperthyroidism were produced in cats by anastomosing the vagus trunk into the superior cervical sympathetic. We can well assume, therefore, that the functional activity of the thyroid is controlled by sympathetic fibers. Ligation of the superior thyroid poles brings about an interruption of the impulses reaching the gland from the superior cervical sympathetic ganglion, since the branches from this ganglion reach the gland in company with the superior thyroid artery, and are ligated with these vessels. Thirty specimens, including segments of the superior thyroid artery and vein, removed during ligation and from necropsy specimens, were studied microscopically. Many small nerve bundles were seen to be closely associated with the vessels; others were embedded in the connective tissue. In several gross

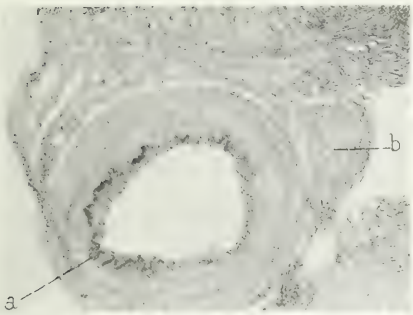

Fig. 11. Section from a normal thyroid showing: *a*, the superior thyroid artery and *b*, the accompanying nerves (x 40).

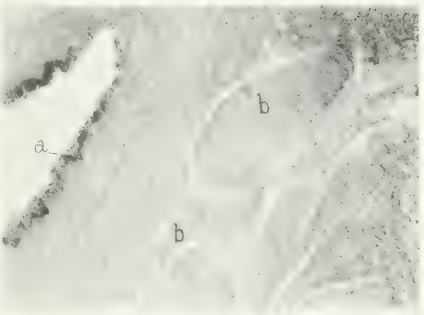

Fig. 12. Section from an exophthalmic goiter showing: *a*, superior thyroid artery and, *b*, large amount of nerve tissue surrounding the artery (x 50).

specimens a small nerve was dissected out and found to follow the course of the superior thyroid artery; it gave off minute branches and entered the gland with the artery. A few microscopic branches not closely associated with superior thyroid artery are found in the loose connective tissue at superior pole; these enter the gland independently of any vessels.

It would appear that in order to get the maximal benefit from ligations of the superior vessels, a polar ligation should be made in addition to dividing and ligating the superior thyroid artery; this would catch the veins, lymphatics, and remaining nerve filaments. Polar ligations alone, do not suffice, for there is no constant point where the superior thyroid artery enters the gland. We have seen patients in whom the superior pole has been ligated, but the artery missed. Pemberton has seen patients whose superior thyroid arteries did not enter the superior pole, but passed directly to the isthmus. In one specimen examined, the principal branch of the superior thyroid passed directly to isthmus, anastomosing with a branch from opposite superior.

The improvement which follows superior ligations is not seen following inferior ligations in spite of the fact that the inferior thyroid artery supplies a much larger area than the superior. This may be explained by the fact that there are only a few microscopic nerve filaments accompanying the inferior thyroid vessels. Another factor that may be of importance, if we assume that the activating material passes from the gland by way of its lymphatics, is that the superior lymphatics leave the gland in company with the superior artery and veins, and are ligated at the same time, whereas no veins or lymphatics accompany the inferior thyroid arteries.

Plummer has noted a drop in the basal metabolic rate in patients who have passed through recent crises, some intercurrent infection, such as tonsillitis, or anything that has caused a reaction. We have noted that the patients who have the sharpest reactions after ligation often show the most improvement when they return in 3 months for thyroidectomy. Neuhof was unable to show uniform changes following experimental ligation of the thyroid arteries and veins in dogs.

The inferior thyroid artery plays such an important part in the mechanism of production and in the surgery of substernal and intrathoracic goiter, that it is worthy of consideration here. The inferior artery ascends in the neck behind the carotid sheath, emerging from between the layers of the prevertebral fascia only a short distance before it enters the capsule on the posterior surface of the gland. This affords a good anchorage for the lower portion of the lobe. Below this point there is considerable gland without any inferior attachment, save the inferior thyroid veins, and they give little or no support. An adenoma developing in this area will follow the line of

least resistance, and hence grow downward between the middle and prevertebral layers of the deep cervical fascia, into the mediastinum. In removing such a gland it is important to begin at the superior pole and work downward, dividing the inferior thyroid artery close to the gland before attempting removal, and thus avoiding serious hæmorrhage. The control of hæmorrhage in surgery of the thyroid, especially exophthalmic goiter, is still of serious importance.

Velpeau, Kocher, deQuervain, Jones, and others routinely dislocate the gland inward and ligate the inferior thyroid arteries and then the superior vessels before starting the thyroidectomy. The objections to this procedure are the possibility of injury to the recurrent laryngeal nerve, and occasional tetany.

Certain surgeons place hæmostats around the lobe with a tight rubber band beneath them, and cut the gland across above the hæmostats, suturing the cut surface. Helgenberg recommends suturing the sternothyroid muscle or pieces of the sternocleidomastoid muscle to the bleeding surface of the remnant of the thyroid gland.

The running, over-and-over sutures, lock sutures, continuous mattress sutures, and interrupted mattress sutures have all been used, the last-named being the most satisfactory. Murphy has often said that great care should be taken to see that every vessel is found, clamped, and ligated in order to insure hæmostasis. After operation the patient should be made to cough or strain. This will cause bleeding from any veins that have collapsed and have not been ligated. Finally, the wound should be packed with gauze if there is any doubt about the hæmostasis.

Postoperative hæmorrhage is no longer a common occurrence. If it does occur, it comes on from a few hours to 72 hours after operation and is generally from an inferior thyroid vein or from a branch of the inferior thyroid artery. Often no definite bleeding point can be found. Hæmorrhage after the third day is extremely rare and is always due to infection.

CONCLUSIONS

1. The thyroid has a very rich arterial and venous blood supply.

2. There is an extensive anastomosis not only between vessels of the same lobe, but also with those of the opposite lobe.

3. In the event of ligation of all four thyroid vessels the circulation can be re-established through extraglandular anastomosis.

4. The secretory activity of the thyroid gland is under nerve control.

5. After ligation of the superior thyroid artery a polar ligation should be made in order to cut off the veins, lymphatics, and remaining nerve filaments.

6. Control of hæmorrhage is best accomplished by interrupted mattress sutures placed through the remaining gland tissue, by ligation of all bleeding points, and by the use of gauze packing in the wound if necessary.

7. Bleeding veins can often be demonstrated by having the patient strain or cough before the wound is closed.

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HISTOLOGICAL STUDY OF THE EFFECT OF LIGATION OF THE THYROID VESSELS IN EXOPHTHALMIC GOITER[1]

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BOOTHBY demonstrated in a series of 55 cases that before treatment the average basal metabolic rate was +68 per cent and the body weight 52.3 kilograms and that following two ligations and at least 2 months' rest, the basal metabolic rate had dropped to +43 per cent and the weight had increased to 56.6 kilograms. In a series of 42 cases in which ligation was performed followed in a week or two by thyroidectomy, the basal metabolic rate before treatment was +60 per cent and 10 days after the ligation +39 per cent. Boothby's detailed study confirms the general opinion held at the Mayo Clinic that ligation is of distinct value in decreasing the intensity of the intoxication of exophthalmic goiter (12).

The present study on the histology of the thyroid gland was made for the purpose of determining, if possible, whether any consistent involution changes could be demonstrated following ligation and, if such changes were found, whether or not they could be correlated with the clinical course of the case between the date of ligation and the thyroidectomy. So far as we have been able to ascertain the literature does not contain similar studies, although Wilson made such studies on a small series of thyroids several years ago, but did not publish them (14).

The thyroid glands studied were obtained immediately after thyroidectomy and sections approximately 9 by 9 by 4 millimeters were cut with a sharp knife and fixed in 10 per cent formalin. Precautions were taken to obtain the sections from each pole at a point as near as possible to the entrance of the vessels into the gland. Other sections were taken from each lobe at a point midway between the superior and inferior thyroid arteries. After the sections had been fixed they were cut with a freezing microtome about 10 to 12 microns thick and stained with hæmatoxylin and eosin. The vessels of the glands had been ligated at one or more poles for from 5 days to 302 days before thyroidectomy. The portion of the gland away from the ligated pole served as a control. We also made sections for controls from fifty unligated hypertrophic parenchymatous thyroids in various stages of the disease.

In order fully to understand the changes that take place following ligation of one or more of the thyroid vessels, it is important to consider the possible collateral anastomosis. Usually four arteries, two superior and two inferior, and occasionally also an anomalous artery, the thyroidea ima, supply blood to the thyroid gland. The superior thyroid arteries arise from the external carotids and divide into two branches, the anterior and posterior rami. The posterior branch anastomoses with branches of the inferior thyroid and the ramifications of the superior thyroid from the opposite side. The inferior thyroid arteries arise from the thyroid axes, enter the gland from the sides, and break up into branches, which, for the most part, ramify on the posterior surface. The thyroidea ima, when present, usually arises from the innominate artery, follows the trachea upward, and enters the thyroid from below. Pettenkofer believes that there is a widespread collateral circulation of the thyroid gland. Briefly, he concludes that there is an anastomosis between the thyroid arteries and the arterial network surrounding the œsophagus and trachea, and between the thyroid arteries and the external maxillary, lingual, ascending pharyngeal, sternocleidomastoid, and cricothyroid arteries. Madlener quotes Enderlen and Hotz who found that, following the ligation of all the thyroid arteries, collateral circulation is established from the carotids, from the arteries

[1] Under the supervision of Dr. A. C. Broders, Section on Surgical Pathology, and Dr. W. M. Boothby, Section on Clinical Metabolism

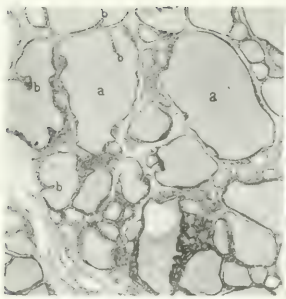

Fig. 1.

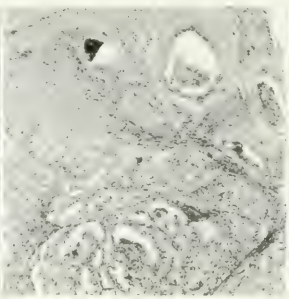

Fig. 2.

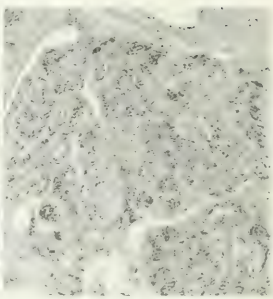

Fig. 3.

Fig. 1. Section taken from ligated pole 126 days after bipolar ligation. *a*. Predominance of large follicles lined with low cuboidal epithelium, and filled with colloid material *b*. Sprig-like processes projecting into lumina of follicles. (X37) (Case A346892.)

Fig. 2. Thrombosis of vessels near capsule with fibrosis surrounding them and invading the neighboring follicles 96 days after bipolar ligation. (X37) (Case A377393.)

Fig. 3. Marked increase of the follicular fibrous connective tissue with desquamation and pyknosis of the follicular epithelium, 93 days after bipolar ligation. (X37) (Case A343846.)

of the œsophagus and trachea, and even from the aorta.

The nerve filaments have been demonstrated by Mastin and others to accompany the superior thyroid vessels to the gland. The value of this observation is obvious in the light of the experiments of Cannon, Binger, and Fitz, who have shown that the superior sympathetic ganglia influence the activity of the thyroid gland. Wilson has histologically demonstrated degenerative changes in the cervical ganglia of patients with exophthalmic goiter and has produced experimentally, by inducing local infection in the cervical sympathetic ganglia of dogs and goats, changes in the thyroid gland which parallel changes in the various stages of progressive and regressive exophthalmic goiter.

The exact involution changes from active hyperplastic thyroids to quiescent are not definitely known. The increase in the size of the follicles with accumulation of colloid, the transition of the epithelium from high columnar to cuboidal, the desquamation of the epithelial cells, and the occurrence of large irregularly shaped cells have been regarded by various observers, notably Marine and Lenhart, and MacCallum, as criteria of involution. From our observations, as will be shown, these changes have been present in glands from patients in whom there was strong evidence that the activity of the thyroid was diminishing.

The 50 cases of this series are divided according to the type of ligation into: Group 1, 15 cases of unipolar ligation; Group 2, 20 cases of bipolar ligation; Group 3, 12 cases of tripolar ligation; and Group 4, 3 cases of quadripolar ligation.

We have carefully studied the histological picture of sections taken from the gland nearest the ligated vessels, noting particularly the size of the follicles, the type of epithelium lining them, and the amount of colloid present. The presence or absence of desquamation and pyknotic changes occurring in the nuclei, and the relative amount of intrafollicular fibrous connective tissue were noted. The changes found in the gland at the site of ligation were compared with those of the unligated portion. The frequency of involution change in the several groups studied is summarized in Table I.

The most constant finding of the early period in the sections taken near the ligated areas was a tendency for the lumina of the follicles to be large and filled with colloid. The majority of these were lined with low columnar or cuboidal epithelium. The relic of the infolding of the wall of the follicles was represented by "sprig-like" processes projecting into the lumen (Fig. 1). Careful search

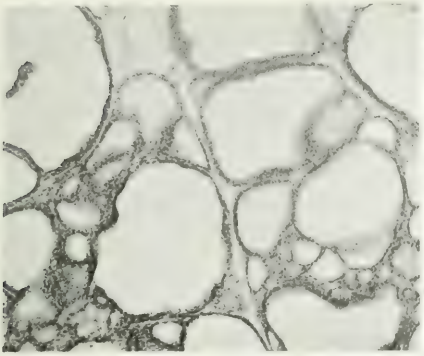

Fig. 4. Large follicles lined with cuboidal epithelium and sprig-like processes projecting into the lumen of a follicle, 5 days after unipolar ligation. (X50) (Case A350615.)

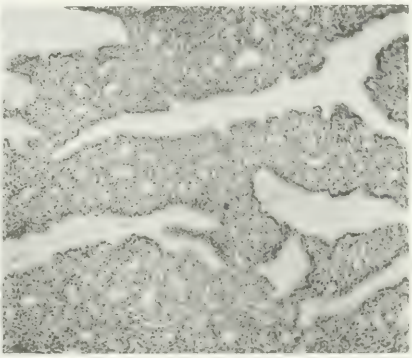

Fig. 5. High columnar epithelium lining the follicles of the unligated pole. Compare with Figure 4. (X50) (Case A350615.)

revealed that the portion of the gland far from the entrance of the ligated vessels was surprisingly free from these changes and apparently more active than the one near the entrance of the ligated vessels, as shown by the abundance of parenchymatous hypertrophy. The epithelium lining the follicles in the ligated portion apparently tended to become cuboidal and, later, in areas, there was desquamation of the lining cells. Occasionally there were large, irregular, granular, deep-staining, degenerative cells, described by MacCallum. In some of the late cases increase of the fibrous tissue stroma was the rule. This was most marked in the region of the capsule, near the thrombosed vessels, and extended into the neighboring parenchyma (Fig. 2). In a few cases this change was so extensive as well to deserve the name given by Marine "cirrhosis of the thyroid gland" (Fig. 3). Pyknotic changes in the nuclei were also present in this type of degeneration.

The involution changes described, except thrombosis, have been invariably present in various degrees in hypertrophic parenchymatous thyroids, the vessels of which were not ligated, but in no instance were these changes circumscribed to and accentuated in any limited portion of the gland, as often noted after ligation. The following reports of cases illustrate the involution changes found in the ligated pole as compared with those in the unligated pole.

REPORTS OF TYPICAL CASES

Case 1. Miss L. M. (A350615), age 16, with exophthalmic goiter, had a basal metabolic rate of +31 per cent February 25, 1921. March 4, the left superior thyroid vessels were ligated with silk. Five days later partial thyroidectomy was performed. The gland removed weighed 28 grams. The cut surface of the left upper pole of the gland near the entrance of the vessels was pale yellow to pink in

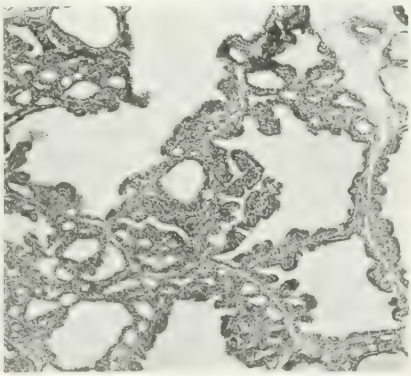

Fig. 6. Marked activity in the unligated pole; compare with Figure 1. (X50) (Case A346892.)

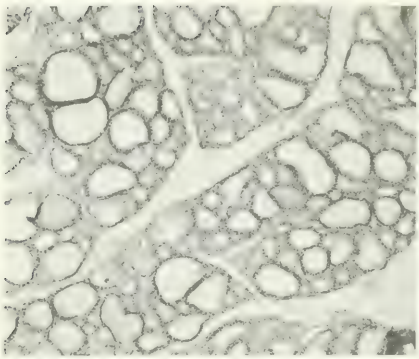

Fig. 7. Follicles lined with low cuboidal epithelium; remains of infolding processes represented by denuded sprigs; 168 days after bipolar ligation. (X50) (Case A208999.)

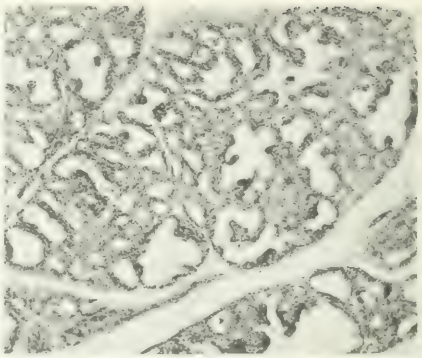

Fig. 8. Section from unligated pole, showing marked parenchymatous hypertrophy. Compare with Figure 7. (X50) (Case A208999.)

comparison to the flesh color elsewhere. Microscopic sections revealed the follicles of the gland near the ligated vessels to be distended with colloid material. The epithelium lining these follicles was cuboidal. Scattered throughout the section were many sprig-like processes projecting into the lumen, and follicles lined by high columnar epithelium were present in only a few areas. Sections taken from the other poles were more active, as shown by the predominance of the typical architecture of hypertrophic parenchymatous thyroid (Figs. 4 and 5).

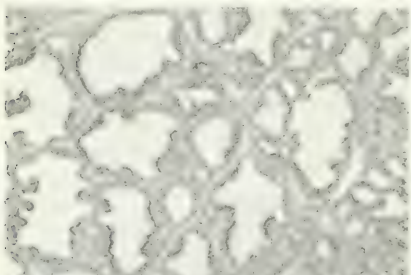

Fig. 9. Marked activity 168 days after unipolar ligation. This is typical of the entire gland. (X50) (Case A[illegible].)

Case 2. Mr. H. B. (A346892), age 38, with exophthalmic goiter, had a basal metabolic rate of +94 per cent January 21, 1921. January 25, the left superior thyroid vessels were ligated and February 1, the right superior vessels were ligated. May 27, the basal metabolic rate had decreased to +62 per cent and during the interval of 4 months' rest, the patient gained 15 pounds in weight, was stronger and clinically much improved. June 1, partial thyroidectomy was performed. The portion of gland removed weighed 90 grams. The cut surfaces of the superior poles were similar to the left superior pole described in Case 1. The sharp contrast between the ligated superior pole and the unligated inferior pole is shown in Figures 1 and 6.

Case 3. Mrs. E. B. (A208099), age 55, with exophthalmic goiter, had a basal metabolic rate of +62 per cent September 23, 1921. Five days later the left superior thyroid vessels were ligated with silk. October 5, the right superior thyroid vessels were ligated. During the next 5 months the patient gained 9 pounds in weight, became less nervous and gained in strength. The basal metabolic rate decreased to +30 per cent March 10, 1922. A partial double thyroidectomy was performed March 16. The portion of the gland removed weighed 18 grams. The microscopic pictures illustrating the sharp contrast between the ligated superior pole and the unligated inferior pole in one lobe are shown in Figures 7 and 8.

Case 4. Mrs. N. D. (A363068), age 64, with exophthalmic goiter, had a basal metabolic rate of +61 per cent August 4, 1921. August 9, the left superior thyroid vessels were ligated, and August 16, the right superior vessels were ligated. The patient was then sent home for a rest and returned 3 months later, November 17, not having gained in weight or

improved in general symptoms; the basal metabolic rate was +69 per cent. December 13, 5 cubic centimeters of hot water were injected in the right lobe of the thyroid gland. December 17, the basal metabolic rate was +56 per cent, and 3 days later the right inferior thyroid vessels were ligated. January 30, 1922, the basal metabolic rate was +59 per cent; there was no gain in weight; the following day partial thyroidectomy was performed. The portion of the gland removed weighed 65 grams. Histologically, it showed marked diffuse parenchymatous hypertrophy, as in Case 5 (Fig. 9), without any evidence of involution changes.

Case 5. Mr. A. P. (A346121), age 44, with exophthalmic goiter, had a basal metabolic rate of +77 per cent January 13, 1921, which gradually increased to +86 per cent, February 7. February 15, and again 7 days later, 5 cubic centimeters of hot water were injected into the left lobe of the gland. The basal metabolic rate February 22 was +70 per cent. February 24, the left superior vessels were ligated. The patient returned to the Clinic the following July feeling better, although he had lost 14.5 pounds in weight during the interval. The basal metabolic rate was +84 per cent and the pulse rate 145. The patient was put to bed and roentgen-ray treatment was instituted. October 21, the basal metabolic rate was reduced to +58 per cent. The patient was sent home for further rest and returned the following December with a basal metabolic rate of +55 per cent and a gain of 26 pounds in weight. December 15, the right inferior and superior thyroid arteries were ligated and 11 days later both vessels on the opposite side were ligated. December 31 the basal metabolic rate was +39 per cent. The patient again went home and returned to the Clinic, February, 1922, much improved. The basal metabolic rates were +36 and +41 per cent February 28 and March 1, respectively; gain in weight was 29 pounds. March 2, bilateral partial thyroidectomy was performed. The portion of gland removed weighed 80 grams. Histologically, it showed marked diffuse parenchymatous hypertrophy (Fig. 9); definite histological involution changes could not be found.

Of the 50 cases of ligated hypertrophic parenchymatous thyroid studied in detail, definite involution changes were found in 33 (70 per cent), while sufficient distinguishing contrast between the ligated and unligated poles could not be demonstrated in the remaining 15. Definite involution changes were found in 10 (66 per cent) of the 15 cases of Group 1, in 14 (70 per cent) of the 20 cases of Group 2, and in 7 (46 per cent) of the 15 cases of Groups 3 and 4 combined.

In the 35 patients with definite involution changes in the ligated pole, 4 showed slight or questionable changes, and 15 showed no changes that could be attributed to ligation. No relationship between the time of ligation and that of partial thyroidectomy was demonstrable. A careful review of the clinical course of the disease following ligation disclosed that, on the whole, definite clinical improvement and a lowering of the basal metabolic rate occurred more often in cases in which definite involution changes were demonstrable in the ligated poles. On the other hand, 8 definite and a few other probable but indefinite exceptions occurred; in these cases there was no evidence of correlation between the clinical symptoms and the histological findings of involution changes. Our data do not indicate whether or not the involution changes noted following ligation of the vessels are attributable to the decrease in the blood supply or to the division of the sympathetic nerves accompanying these vessels.

TABLE I.—DEFINITE AND INDEFINITE CHANGES AFTER LIGATION

Type of Ligation	Cases	Involution changes		
		Marked	Slight	Indefinite
Unipolar	15	10	1	4
Bipolar	20	14	..	6
Tripolar	12	5	3	4
Quadripolar	3	2	.	1

In general, this study shows that distinct clinical improvement and lowering of the basal metabolic rate occurred more often in those cases in which definite involution changes in the ligated pole could be demonstrated histologically. On the other hand, a few definite exceptions demonstrated that a correlation between the clinical findings and the presence or absence of involution changes is not to be expected in all cases.

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HÆMORRHAGE FOLLOWING ABDOMINAL OPERATIONS

With Special Reference to Appendicectomy and Excluding Bleeding from the Stump

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ALTHOUGH there exists a fair amount of literature concerning gastro-intestinal hæmorrhage following abdominal operations, yet the number of actual cases, outside of hæmorrhage following gastro-enterostomy for duodenal ulcer, is small.

Intestinal hæmorrhage following an operation for hernia, especially a strangulated hernia, might be expected *a priori*, as the intestine is often seminecrotic and there are other morbid conditions. Luksch, in a statistical report published in 1898, found that there was about one enterorrhagia for every hundred operations for strangulated hernia. Sauvé was able to collect fourteen such cases from the literature, covering only a limited period.

But postoperative hæmatemesis following general abdominal operations is a very rare complication. The earliest cases reported seem to be those of Broca in 1864 and Le Fort in 1873. These cases did not, however, arouse much interest among surgeons. Schnitzler, Ullmann, and Kukula wrote important contributions to the literature of postoperative enterorrhagia, especially following hernia operations. Schnitzler called attention particularly to the immediate postoperative hæmorrhages and Ullmann to those occurring six months or later after operation. Kukula wrote on the importance of venous thrombosis in connection with the question.

The textbooks do not refer to postoperative gastric or intestinal hæmorrhage without any visible lesion and without apparent cause. In his oration on surgery delivered before the American Medical Association meeting at Atlantic City in 1900, Rodman described this condition. Rodman interrogated fifty leading surgeons and nine reported having observed cases of postoperative hæmatemesis. Finney, of Johns Hopkins, was not aware that a case had ever presented itself in the hospital of that institution up to that time. Robson had reported seven cases as occurring in his own practice, two of which were fatal, and von Eiselberg six cases, and three fatal cases by Reichard, in 1889. Johnston, of Richmond, had recorded five cases, three fatal, but accompanied by general peritonitis. Postoperative hæmatemesis has occurred after abdominal operations done upon the peritoneum, omentum, intestines, gall bladder, kidney, uterus, and ovaries. The disorder arises from the second to the tenth day subsequent to operation. Rodman regards sepsis as the

etiological factor. The sum total of all the hernia operations done by the fifty surgeons to whom Rodman had written must be many thousands, and yet but two cases of postoperative hæmatemesis are reported, and each was satisfactorily explained, one patient dying of peritonitis following strangulated hernia, the other from a duodenal ulcer demonstrated by autopsy. All of the cases seen by Robson and Eiselsberg followed intra-abdominal operations, such also being the case with all postoperative hæmatemeses reported by American surgeons, excepting two cases where nephrorraphy had been done. In doing nephrorraphy the peritoneum may, in the first place, be incautiously opened by the most careful operator, and secondly, there is always a considerable amount of traumatism necessary to force the kidney into the lumbar incision. It is not, therefore, difficult to understand how a hæmatoma may easily be produced by the great abdominal pressure oftentimes necessary to bring the kidneys into view, and how, furthermore, this extravasation may occasionally cause sapræmia, septicæmia, or peritonitis according to the circumstances. All septic conditions favor disintegration of the blood corpuscles and predispose to hæmorrhage from mucous surface. The gastric mucosa is particularly liable to congestion in conditions of sepsis, both on account of the marked tendency of the thin, and more or less disintegrated blood to settle in the internal organs, and the vomiting and retching so frequently present.

As hæmatemesis and enterorrhagia following general abdominal operations are therefore rare complications, it is only logical to deduce that cases of this nature following appendicectomy as a distinct class of abdominal operations, would be very few. I have recently observed a case of this kind which I describe below; and a fairly thorough search through the literature has revealed only 43 other cases which are described in the accompanying tabular statement. Many of these reports are meager and hence full particulars cannot be given.

The first case of hæmatemesis following appendicectomy was reported by Duckworth in 1889. Guy and Carlas reported a similar case in 1899. Since then I find that 43 cases have been reported.

Patient, female, age 16, student, athletically inclined. Patient holds several endurance records for swimming. Past illnesses and family history are not important. Menstruation began at 14, has been regular, of 28-day type, of 3 to 4 days' duration, and is not accompanied with pain.

Present illness began about 10 days prior to entrance to hospital, while she was at college. She was wakened from sleep by severe colic-like abdominal pains, followed by repeated attacks of nausea and vomiting—first stomach contents then bilious material. Temperature 100°. The attending physician made a diagnosis of acute appendicitis. Ice bags were applied and feeding suspended. The pain localized over McBurney's point in a few hours. After several days the symptoms subsided. Patient was confined to bed for a week, after which physician advised surgery and she was sent home, arriving at her parents' home February 3. She entered Washington Park Hospital 3 days later.

Physical examination on entrance revealed some local tenderness over appendix; slight tympany, temperature 99°, pulse 116, respiration 20. Leucocytes, 9,400; urine, negative; no previous gastric or duodenal history; chest, negative; heart, no valvular defects but slight tachycardia; no palpable thyroid or tremor.

Preliminary preparation. A soapsuds enema was given the evening before operation. Operation February 9, 1922. Gas anæsthesia, McBurney incision. The appendix was of the retrocæcal type, pointing upward. Old adhesions bound appendix to cæcum and postperitoneal wall. The tissues still showed marked infiltration and evidence of the recent inflammatory attack. Because of the limited space and the marked fixation of appendix I was compelled to enlarge the incision so as to deliver it satisfactorily. The mesentery was crushed with heavy forceps and ligated, the suture including the cæcal serosa.

The appendix stump was crushed and ligated. The stump was inverted with a purse-string suture of linen. Complete hæmostatis was maintained at all times. The abraded surface was covered with peritoneum with Lembert sutures. The bowel was returned and no bleeding followed. The wound was closed, and the patient awake before she left operating room. She was returned to bed with pulse of 100: she was warm, in good condition, and had an excellent day and night. On the evening of the second day about 10 p.m. she suddenly awakened from sleep, was very restless and excited. She had no pain, but her pulse was 142 and weak. Slight tympany was present. Percussion of stomach showed slight distention. Gastric lavage returned with some bile and mucus. A 1–2–3 enema expressed with large quantities of dark semi-fluid blood, followed later by repeated copious quantities of bright blood in the stool. The foot of the bed was

elevated, and 10 cubic centimeters thromboplastin administered intramuscularly. Red blood count taken at this time showed very slight change, 4,360,000. Pulse became more rapid, over 160, impossible to count. Air hunger became pronounced. More blood was found in stools. Progressive evidence of hæmorrhage was unexplained.

I felt that the possibility that the stump was the cause of the bleeding was just reason for re-opening the abdomen, which I did under gas anæsthesia, through a right rectus incision, in order to gain better vision. Inspection revealed a stump in excellent condition, with no evidence of hæmorrhage. The bowel blood content gave a dark bluish cast. The abdomen was closed. Ten minutes were required to make the examination. Patient was returned to bed, and the foot elevated. She was given large doses of morphine at frequent intervals; pulverized charcoal *ad lib.* was given per mouth; and 4 cubic centimeters of thromboplastin administered intravenously. Signs of hæmorrhage continued until the red blood reached 3,000,000 and hæmoglobin 50 per cent, at which time she received 20 cubic centimeters of fresh rabbit blood intramuscularly. Donors were typed for transfusion. Slight improvement, however, made transfusion unnecessary. Hæmorrhage was controlled on fifth day. Her recovery was gradual and uneventful. Both wounds healed *per primam*. A complicating feature of this case was the tachycardia, which necessarily made it difficult to ascertain a true clinical picture. Since recovery she shows a + 13 basal metabolism.

In conclusion I desire to state that I have by exclusion ruled out the usual causes of intestinal hæmorrhage. Also I am positive that this case did not originate from an inverted stump. However, it does seem logical to me that the slight trauma experienced in trying to deliver the appendix through a McBurney incision could have been responsible for thrombosis with a resulting embolism of the walls of the intestine, and later ulceration and hæmorrhage.

In the 43 cases collected there were 21 recoveries, 21 deaths, and 1 in which the result is not stated.

In 5 cases, those of Mitchell, Pybus, Theleman, Schwalback (2 cases), the hæmorrhage was from the bowel. All of these patients recovered. In one case (Muehsam), the hæmorrhage was both from stomach and bowel. Patient died.

In 7 cases the hæmorrhage was from the wound, viz., the cases of Torrance, White, Skevington (2 cases), Corner, Ward, and Karpeles. Five of these patients recovered and 2 died. It is doubtful if these cases should be included.

In the 26 cases with a gastric hæmatemesis, there were 17 deaths. It is easily seen, therefore, that this type of postoperative hæmorrhage is far more fatal than any other, giving a mortality of more than 65 per cent.

In 3 cases the nature of the hæmorrhage is not clearly stated. In 4 of the wound-hæmorrhage cases the deep epigastric artery was involved; and in one case the external iliac artery. Erosion of the vessels is specifically mentioned in 5 other cases, and the occurrence of ulcers in stomach and duodenum is noted in 4 cases.

Comparing these results with hæmorrhage after general abdominal operations Busse reported 14 personal cases of this type and collected 82 others from the literature. The mortality in this series of 96 cases was 55 per cent, which is much the same as in the appendicectomy cases.

The exact etiology of postoperative hæmorrhages following abdominal operations has never been satisfactorily settled. Karpeles says that direct hæmorrhage after appendicectomy has been noted from the superficial abdominal vessels, the meso-appendix, the bowel, the abscess cavity, and from the deep epigastric and external iliac arteries. Secondary hæmorrhage is caused by a purulent periarteritis arterionecrosis taking place.

In addition to the cases reported in the annexed table, hæmorrhage from the bowel arising from the stump of the appendix has been reported a number of times. Mitchell's case in the table appears to be of this type, but Mitchell distinctly states that re-operation showed that the bleeding was not from this source.

In a report by Wyeth on the technique of appendicectomy, he refers to postoperative hæmorrhages from the stump. He states that Deaver had 2 cases, Hessert 3 cases, Knoth 2 cases, Halstead 2 cases, and Graham, Lund, Hughes, Nicholson, Laplace, Fowler and Elsberg, each 1 case. Judd of Honolulu reported a similar case.

In 6 of these 16 cases reported by Wyeth of postoperative bleeding from the bowel, it was clearly proved, by re-operation in 5 and by postmortem in 1, that the hæmorrhage came from the inverted stump of the ap-

TABLE I.—SUMMARY OF FORTY-THREE CASES COLLECTED FROM THE LITERATURE

Case No.	Reported by	Age and Sex	Nature of Disease	Treatment	Postoperative Course	Results	Remarks
1	Sir D. Duckworth Med. & Surg. Tr., 1880, lxiii, 343	M. 16	Gangrene appendix	Operation	Hæmatemesis 8th day	Recovery	
2	Guyot and Carlas. Bull. Soc. anat. et physiol. de Bordeaux. 1880 Nov. 20	M. 14	Appendicitis	Operation 6th day	Vomited black blood evening following operation	Death	Autopsy: Stomach distended with blood; stomach mucosa was ecchymotic in spots.
3	Charlot. Thèse de doct., Paris, 1900	— 8	Appendicitis with peritonitis	Operation 5th day	Morning following severe vomiting black blood	Death	Autopsy: Hæmorrhagic spot on the stomach mucosa; some blackish adherent masses and craterform depressions containing black masses of the dimensions of a pinhead.
4	Ibid.	— 9	Appendicitis with peritonitis	Operation 3rd day	Eight to ten hæmatemeses	Death	Autopsy: hæmorrhagic spot on stomach mucosa.
5	Ibid.	8½	Appendicitis with peritonitis	Operation	Vomited dark fluid	Death	Autopsy: 100 grams of black blood found in the stomach. Two large eroded placques in the stomach mucosa.
6	Kermisson, E. Gaz. hebdom., 1900, v, 1	F. 7	Appendicular abscess in right iliac fossa	Operation 4th day	Enormous hæmatemesis	Death	
7	Mintz, W. Mittl. a. d. Grenzgeb. d. med. u. Chir., 1906	M. 40	Appendicular abscess	Operation	Hæmorrhagic vomiting immediately after operation	Death on 5th day	Autopsy: Liver atrophy. Erosions in small curve of stomach; obliterated arterial lumina
8	Walsh. Bull. Soc. de chir., Paris, 1901, xxvii, 374-375. (Reported by Berger)	M. 40	Appendicitis. Tumor consisted of a mass of omentum indurated and adherent to cæcum	Operation. Ligated around base of appendix but did not cover stump with serosa	Patient developed right-sided pleurisy 3 days after operation. Vomited 900-100 c.cm. of blood mixed with stomach contents, passed large quantity of blood per rectum	Recovery	Attributes hæmorrhage to slipping of ligature
9	Championnière, L. Bull. Acad. de méd., 1902, ii, 19	F. 30	Gangrene appendix	Operation	Vomited black blood. Stomach lavage with soda water. Serum injection	Recovery	Patient 6 months graved.
10	Ludwig, Ernst. Wien klin. Wchnschr., 1903, xvi, 737	M. 18	Appendicular abscess	Operation. Gangrene appendix	Hæmatemesis	Death.	Autopsy: Hæmorrhagic eroded stomach; small capillary thrombi
11	Landow, M. Arch. f. klin. chir., 1902, lxvi, 1060-1068	M. 30	Appendicular abscess	Operation	Hæmorrhagic vomiting following day	Recovery	
12	Sano Dissertation Munich, 1905	M. 51	Appendicular abscess and circumscribed peritonitis	Operation 4th day	Following day severe hæmatemesis	Death	No autopsy
13	Ibid.	M. 39	Acute appendicitis	Operation	Hæmatemesis following day	Death on 4th day	Autopsy: Ulcers in pylorus and duodenum, in the first an open blood vessel
14	Ibid.	M. 14	Appendicitis with diffuse peritonitis	Operation	Following day vomited dark fluid	Death 7 days later	Autopsy: Ulcer on stomach near pylorus with eroded vessel
15	Pave. Zentralbl. f. Chir., 1906	Not stated	Chronic appendicitis	Operation. It showed omentum much inflamed, during the operation observed thrombosis of omentum. Part of omentum resected	Gastro-intestinal hæmorrhage on 7th day	Recovery	

TABLE I.—SUMMARY OF FORTY-THREE CASES COLLECTED FROM THE LITERATURE—CONTINUED

Case No.	Reported by	Age and Sex	Nature of Disease	Treatment	Postoperative Course	Results	Remarks
18	[illegible]	M. [illegible]	Acute appendicitis	Operation	Heavy hematemesis following day. On 13th day wound reopened on account of [illegible]	Recovery	
19	[illegible]	M. 28	Appendicitis of appendicitis	Appendicectomy for symptoms	Severe hematemesis 1st and 2nd day	Recovery	
20	[illegible]	M. 34	Appendicitis	Appendicectomy a fraud	Severe hematemesis the first three days	Recovery	Appendix and cæcum fixed by adhesions to anterior abdominal wall
21	[illegible]	M. [illegible]	Chronic appendicitis	Operation. Mesenterial necrotic abscess	Hematemesis 1st and 2nd day	Recovery	
22	[illegible]	M. 12	Appendicitis with diffuse peritonitis	Operation. Gangrene appendix	Hematemesis 6 days later	Death	Autopsy: Necrotic duodenal ulcer; pancreatico-duodenal artery eroded.
23	[illegible]	M. [illegible]	Acute appendicitis	Operation. Gangrene appendix, perforation	Bloody vomit and stools on 7th day	Death on 10th day	Autopsy: Peritonitis duodenal ulcer with erosion of gastro-duodenal artery
24	[illegible]	F. 28	Acute appendicitis	Operation. Appendix and cæcum adherent. Pus in appendix	Severe bloody stools after 3 days continuing until 9th day	Recovery	
25	[illegible]	M. [illegible]	Acute appendicitis	Operation. Appendix buried in adhesions with cæcum, etc.	Tarry bloody stools on 5th day continuing for 6 days	Recovery	
26	[illegible]	M. [illegible]	Appendicular abscess	Operation. Appendix perforated	Bloody stools after 14th day	Recovery	
27	[illegible]	F. 26	Ruptured [illegible] salpingitis. Appendix removed with pus	Operation. Appendix crushed and buried in by means of a Cargat purse-string suture	11 hrs. after operation, patient restless, pallid. Pelvis opened found perfectly dry, no hæmorrhage. Following day emesis bright away large bloody stool. Five more bloody stools passed. Day following vomiting of dark blood	Recovery	Author reports case because hemorrhage did not come from inverted stump.
28	[illegible]	M. [illegible]	Ulcerating [illegible] appendix. Perforation	Operation		Death	Patient succumbed asphyxiated by violent hæmatemesis on 3rd day after operation.
29	[illegible]	[illegible]	Appendicitis 3 days duration	Operation. Appendix removed. Cæcum sutured to anterior abdominal wall. Lower wound cavity filled with packing	Two days after operation vomited about one quart of black blood	Recovery	
30	[illegible]	F. 30	Appendicitis	Operation. Death day. Appendix [illegible]	Day after operation vomiting of blood	Death	Patient succumbed to final hemorrhage, trickling into trachea and bronchi
31	[illegible]	[illegible]	Appendicitis. Third attack	Operation. Concretions appendix removed	Complicated by severe hæmatemesis	Not stated	
32	[illegible]	M. [illegible]	Appendicitis 3 days duration	Operation. Pelvic abscess, diffused peritonitis, gangrenous	Day 1 Bowels evacuated [illegible] grams black blood	Death	Operation delayed 11 hrs. by bandy, gangrenous patches on cæcal walls
33	[illegible]	F. [illegible]	Appendicitis and peritonitis	Operation [illegible] later. Appendix gangrene	Two day later vomited black blood	Died	Death occurred in attack of vomiting blood
34	[illegible]	M. [illegible]	Appendicitis	Operation. Anterior vertical through rectus sheath	Ten days after operation hæmorrhage occurred. Arrested clinically by clamping. Three days later, [illegible]	Death	Transfusion in vein. Patient [illegible] week. Hemorrhage from deep epigastric artery

33	Goodman, H. Brit M. J., 1911, ii, 920	F.	Appendicitis	Operation. Long irritable appendix dipped behind cæcum toward pelvis brim. No difficulty	Following day vomited half a pint blood, and some clots. Adrenalin, ice, strychnine, limbs bandaged, foot of bed elevated	Death 56 hrs. after operation	
34	Torrance, G. M. Atlanta J. Rec., 1913-1914, iv, 526	M	Appendicitis	Operation. Found gangrene appendix. Right rectus incision	Hæmorrhage so prolonged bed and floor in a pool	Recovery	Wound tightly packed in lower angle. hæmorrhage stopped. The hæmorrhage was from the deep epigastric artery.
35	White, C. S. Surg., Gynec. & Obst., 1914, xix, 679	M. 41	Acute appendicitis	Operation. Same day. Right rectus incision necrotic appendix, drainage	Fourth night dressings saturated with fresh blood. Following 24 hours same Salt solution per rectum	Recovery	Author attributes cause to deep epigastric artery eroded by drainage tube or opened by an advancing infection.
36	Skevington, J. O. Lancet, Lond., 1914, clxxxvii, 104 105	M. 16	Appendicitis	Operation	Ten days after operation hæmorrhage from lower angle of wound	Recovery	Two deep thread sutures were passed through the whole thickness of abdominal wall at the inner edge of the wound. Hæmorrhage ceased; hæmorrhage from deep epigastric artery.
37	Corber, E. Med. Press & Circ., 1914, n. s. xcviii, 519	M. 10	Acute appendicitis	Operation. Sloughing, appendix lay internal to cæcum. Right rectus incision	Seventh day bandage soaked with blood plugged wound with gauze	Death	Autopsy showed ulceration of the external iliac artery: its walls had suddenly given away.
38	Ward, W. G. Surg., Gynec. & Obst., 1915, xx, 101	M. 24	Acute appendicitis	Operation. Pus oozing from tip of appendix, cigarette drain	Midnight free bleeding. Bleeding continued until 6th day. Cæcal fistula developed. Irrigated with salt solution and in wash a piece of necrotic omentum tissue came	Recovery	Bleeding from wound.
39	Karpales, S. R. Wash. med. Annals, 1917, 16, 171	M. 21	Appendicitis	Operation. Gangrene appendix. Large cavity in same region filled with foul smelling pus was evacuated. Catgut used to ligate mesoappendix and bury stump. Cigarette drain	Hæmorrhage from wound 12 days after operation. In 25 minutes patient was in in a pool of blood	Recovery	Patient presented characteristic picture — pallor, feeble pulse, etc.
40	Drybrough - Smith, E. Lancet, Lond., 1918, cxcv, 15	M. 12	Acute appendicitis first 4 days. Subacute for 4 weeks	Operation. Started to vomit after narcosis. Drainage. Appendix showed circular ulcer of mucosa within an inch of base	Vomited dark brown fluid before leaving operating room. Vomiting continued; quantity 3 to 4 oz. to 8 to 10 oz. every hour lavage, bicarbonate of soda. Adrenalin chloride in 10 min. doses sol 1.1000 every 2 hours)	Recovery	
41	Vere Arkle, J. Lancet, Lond., 1918, cxcv, 861	F. 19	Chronic appendicitis. Severe acute attacks	Operation. Few adhesions. No operative difficulty	Symptoms of hæmorrhage 8 hours after operation. Wound reopened, everything found in order. Vomited dark blood 4 hours later. Continued to vomit dark fluid for hours. Hypodermics of morphine atrophine, etc.	Died 24 hours after operation	No autopsy allowed
42	Ibid.	F. 10	Appendicular abscess	Operation. Appendix gangrenous. Part of omentum gangrenous. Abscess drained	Symptoms of hæmorrhage 6 hours after operation. Wound reopened, no sign of hæmorrhage there. Intense dark vomit 12 hours after operation and continued till death	Died 16 hours after operation	No autopsy allowed
43	Pybus, F. C. Brit. J. Surg., 1920-1921, viii, 543	M. 47	Chronic appendicitis	Operation	Rise in temperature for several days Maximum 102°. P. 130. Twenty days after operation, passed 2 pints dark blood from bowel with a large clot, iliac fossa tender; hæmorrhage repeated Laparotomy, coil of ileum adherent near perforation at apex of cæcum and hæmatoma adjoining it. Closed	Recovery	Author thinks appendicular artery was punctured and formed a hæmatoma in the mesentery which became adherent to ileum and cæcum and gave rise to the hæmorrhage.

pendix. Thirteen of these 16 cases recovered; 3 died. In this type of hæmorrhage purse-string catgut sutures with insufficient ligation of the appendix stump, or at least of the artery, has been variously incriminated. Judd was not, however, satisfied that his case was due to oozing from the stump but thinks that the hæmorrhage from the bowel in his case (as well as in cases by Walch and Kelly) was similar in origin to "hæmatemesis following abdominal operations."

The hæmatemesis following abdominal operations has long been known as mentioned in the beginning of this paper. The earlier views were that such hæmorrhages were due to arterial thrombosis, especially after hernial operations. The mechanism is arterial ischæmia altering the arteries which rupture, owing to the blood efflux following relief of hernial strangulation.

French surgeons at an early date, as mentioned by Sauvé, attribute these hæmorrhages to a peritoneal infection and consequently think that they are of the same nature as appendicular hæmorrhages. Regnier thought that they were due to paralysis of the mesenteric nerves which produce vasodilatation of the arterial capillaries. The intestinal arterial circulation is regulated by the mesenteric nerves.

But the pathological changes which take place after the various abdominal operations give rise to hæmorrhage either from the bowel or stomach have not as yet been satisfactorily explained. Moynihan states that the hæmatemesis may follow any abdominal operation, but it is especially to be looked for when the stomach, duodenum, or bile passages are the seat of the disease. He mentions five theories, viz:

1. Anæsthetic.
2. Distinct injury to stomach or bowel, resulting in ulceration from which blood comes.
3. (von Eiselsberg) Injury to the omentum, producing a thrombosis of the omentum, which is followed by embolism in the walls of the stomach or bowel.
4. Sepsis (Rodman's theory).
5. Reflex influence (Mayo Robson).

Moynihan thinks Rodman's theory is the correct one.

It will be noted that in several of the cases reported after appendicectomy in annexed table, a necrotic spot was found on the stomach mucosa.

The modern view based on the pathology points to sepsis and toxæmia as the basic cause of the hæmorrhagic lesions; and in the case of a diseased, gangrenous, or perforated appendix, the spread of the infection to some neighboring vessel and thence to the stomach or intestinal wall is easily comprehended. Such a mechanism is well known; for instance, in the case of postoperative hæmatemesis after a gastro-enterostomy has been done for duodenal ulcer.

As stated by Rodman the gastric mucosa is particularly liable to congestion and hæmorrhage in conditions of sepsis.

To my mind trauma or embolism, either separately or collectively, seems a more logical solution of the true cause of this condition than any of the other etiological factors, for in either we may have sepsis and necessarily with both we may have slough, thus the possibility of hæmorrhage.

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THE DISTRIBUTION OF ACID CELLS ALONG THE DORSAL CURVATURE OF THE STOMACH AND THE POSSIBLE RELATION TO THE OCCURRENCE OF GASTRIC ULCER[1]

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IN a previous paper,[2] the distribution of the acid cells along the lesser, greater, and ventral curvatures of the stomach was determined, but the dorsal curvature (an axial line of the dorsal surface) was not surveyed.

As gastric ulcers are more common along the dorsal surface than elsewhere in the stomach, a special study was made of the dorsal curvature to see if there might be a histological reason for the occurrence of this condition.

The two stomachs used were obtained as soon as possible after death and were prepared in the same manner as described in the preceding paper, consequently this detail will not be repeated here.

Although the main interest lay along the dorsal curvature, the greater and lesser curvatures were also studied and the thickness of the mucosa at various points was measured.

In studying the *lesser curvature* in the first case (Fig. 1) we find at the cardiocesophageal junction the oxyntic cells few in number and of medium size. About 2 centimeters from the œsophageal orifice, the cells increase in number and are located mainly in the fundal portion of the glands. The cells become fairly numerous toward the cardiopyloric junction; they also increase somewhat in size and become more numerous in the necks of the glands. At the cardiopyloric junction there is a fairly sharp reduction in the number of oxyntic cells and only a few scattered acid cells are seen beyond the junction. The position of the junction is 60.07 per cent of the distance from the cardiac orifice.

A study of the *greater curvature* in Figure 1 shows at the cardiocesophageal junction, the acid cells practically absent, but cardiac glands numerous. As the cardiac glands cease, the acid glands become quite numerous and are located in the necks of the glands. These acid cells continue fairly numerous, with areas of reduction due probably to catarrhal conditions. Toward the cardiopyloric junction, these cells fluctuate in number and cease fairly sharply at the junction.

The junction is 87.5 per cent of the distance from the cardiac orifice.

The *dorsal curvature* in Figure 1 shows at

[2] Internat. J. Gastroenterol., 1921, July.

Fig. 1. Diagram of stomach No. 4(Zx) indicating the lesser, greater, and dorsal curvatures. The arrows indicate the histological boundaries and those arrows at the points *A* indicate the points of ending of the oxyntic cells (cardiopyloric junction) along the curvatures. This is also indicated in percentage of the distance from the cardiocesophageal junction. The thickness of the mucosa is indicated at various points in fractions of a millimeter.

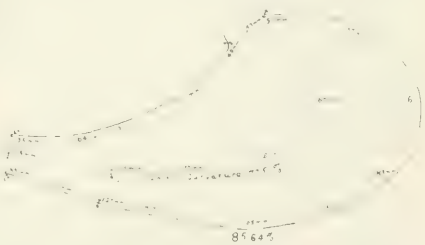

Fig. 2. Diagram of stomach No. 5(Zy). The markings and indications are the same as in Figure 1.

[1] From the Laboratories of the Daniel Baugh Institute of Anatomy of the Jefferson Medical College.

the cardiocœsophageal junction, the cardiac glands numerous and the oxyntic cells few in number. Farther on at first the acid cells are few and scattered. They are located mainly in the necks of the glands. About half way toward the cardiopyloric junction, the acid cells increase in number and are found chiefly in the necks of the glands. From this region to the junction there are alternating decreases and increases in the number of acid cells and a sudden cessation at the junction. The junction is 83.57 per cent of the distance from the cardiac orifice.

The pieces of the *lesser curvature* (Fig. 2) became rather twisted so that the sections were not representative and were discarded.

The *greater curvature* (Fig. 2) shows at the cardiac orifice the cardiac glands numerous and the oxyntic cells few in number. In the beginning of the fundus the acid cells increase somewhat, but are still comparatively few. They are located chiefly in the necks of the glands. From here to the cardiopyloric junction, there are alternating decreases and increases of acid cells, but nowhere are they quite numerous. At the cardiopyloric junction they cease quite abruptly with only a few scattered cells beyond.

The junction is 85.64 per cent of the distance from the cardiac orifice.

The *dorsal curvature* in Figure 2 shows at the cardiac orifice the cardiac glands absent and the acid cells few in number. Farther on the acid cells increase somewhat, but are not to be considered numerous. This is possibly due to catarrhal changes. Well beyond the fundus, the glands become almost normal and the acid cells are quite numerous and are located chiefly in the necks of the glands. Some of these cells are so large that they might readily be called *giant acid cells*. Toward the cardiopyloric junction the cells continue numerous and are located chiefly in the necks of glands, ceasing abruptly at the junction.

The cardiopyloric junction is 77.51 per cent of the distance from the cardiac orifice.

In comparing these results with those obtained in the preceding paper, the following is noted:

Along lesser curvature of the stomach the distribution of the acid cells is a little less than the average of the three organs reported. Taken altogether, however, the average distribution along the lesser curvature is 63.09 per cent. This represents an average of slightly under two-thirds of the distance from the cardiac orifice.

TABLE I.—ACID CELL DISTRIBUTION

No.	Lesser Curv.	Greater Curv.	Dorsal Curv.	Ventral Curv.
1.	57.20	79.40	....	74.25
2.	64.71	74.77	....	79.10
3.	70.40	80.42	....	76.10
4. (Zx)	60.07	87.50	83.57	....
5. (Zy)	....	85.64	77.51	....
Average	63.09	81.55	80.54	76.48

Along the greater curvature the extent of the distribution of acid cells in stomachs Nos. 4 and 5 is greater than in any of the preceding cases. As a result the average distance is 81.55 per cent. This represents over three-fourths of the distance from the cardiac orifice and a greater proportionate distance than along the lesser curvature.

In the two stomachs, Nos. 4 and 5, the acid cells extend farther along the dorsal curvature than they do along the ventral curvature. Along the ventral curvature the distance is 76.48 per cent or just slightly over three-quarters of the distance, while along the dorsal curvature the acid cells extend 80.54 per cent of the distance.

Along the *lesser curvature*, stomachs Nos. 4 and 5 show the mucosa to be quite thin. In No. 4 there is only a slight difference in thickness between cardiac and pyloric areas, while in No. 5 the difference in thickness at the pylorus is more noticeable.

Along the *greater curvature* the same condition prevails in both stomachs.

Along the *dorsal curvature* No. 4 shows no appreciable increase in thickness at pylorus, while No. 5 shows quite marked increase.

In comparing the thickness in the mucosa in the various regions with the corresponding measurements of the stomachs, Nos. 1, 2, and 3, one notes the lack of consistency in these measurements. It would seem as though each stomach were a law unto itself as far as the thickness of the mucosa is concerned. To state flatly that the mucosa is of a stated definite thickness at the cardiac orifice and that this becomes double or more at the

TABLE II.—THICKNESS OF THE MUCOSA OF THE STOMACH[1]

	Cardiac mm.	Fundus mm.	Intermediate mm.	Junction mm.	Intermediate mm.	Pylorus mm.
GREATER CURVATURE						
1.	1.50	1.80	0.90	0.07	0.80	0.75
2.	0.79	0.80	0.79	0.09	0.71	0.00
3.	0.65	0.57	0.79	0.71	0.79	0.75
4.	0.80	0.62	0.71	0.67	0.70	0.86
5.	0.80	0.60	1.05	1.27	1.10	0.93
Average	0.85	0.83	0.85	0.86	0.82	0.78
VENTRAL CURVE						
2.	0.66	0.83	0.83	0.71	0.71	1.00
3.	0.62	0.60	0.70	0.05	0.76	0.61
Average	0.64	0.71	0.80	0.08	0.74	0.80
DORSAL CURVE						
4. (Zx)	0.60	0.71	0.70	0.00	...	0.66
5. (Zy)	0.53	0.67	0.67	1.13	....	1.11
Average	0.57	0.69	0.69	0.88	.. .	0.90
LESSER CURVATURE						
1.	1.4	0.93	1.0	0.86	..	0.86
2.	0.00	0.74	0.86	1.07	.	1.07
3.	0.80	0.79	0.64	0.86	..	0.93
4. (Zx)	0.41	0.69	0.69	0.03	. .	0.86
5. (Zy)	0.40	0.00	0.51	0.04	. ..	0.95
Average	0.71	0.70	0.72	0.83	....	0.88

pylorus, with proportionate increases in the intermediate parts, does not seem wise. The *intermediate* measurements are frequently greater than those at the cardiac orifice.

The average of all measurements along the lesser curvature shows a slight increase in thickness at the pylorus.

Along the *greater curvature* the average thickness of the mucosa at the pylorus is less than that at the cardia (almost the figures along the lesser curvature reversed).

Along the *ventral curvature* the thickness of the mucosa fluctuates, but the pyloric mucosa is slightly thicker than that at the cardia.

Along the *dorsal curvature* there is a gradual increase from cardia to pylorus.

GASTRIC ULCER

With reference to gastric ulcer it is stated that the condition occurs most frequently in the pyloric portion of the stomach and along the dorsal wall. It is stated that 75 to 80 per cent of chronic ulcers occur in the pyloric portion of the stomach. Of those, the lesser curvature seems to have the most, 36 per cent, the dorsal wall 25 per cent and pyloric (orifice region) 15 per cent. The question naturally arises as to whether there is any histological explanation therefor.

The statement as to location is too indefinite. In order to draw any decided conclusions it would be necessary for the surgeon to state exactly how many millimeters from the pyloric orifice the center of the ulcer was located to find out whether or not the ulcer comes within the boundary of the *histological pyloric portion*.

In an earlier paper the writer has definitely shown that the histological and anatomical pyloric dimensions do not coincide so that a more definite location would be necessary, i.e., exact distance from the pyloric orifice.

Another source of help would be to obtain such stomach postmortem and prepare as above and note any change in the acid cells of the neighborhood of the ulcers.

As 75 to 80 per cent of the ulcers occur in the pyloric end, it means that their location is in part free from acid cells or along the border line where they are about to cease. It would seem that these oxyntic cells in some way protect that part of the organ in which they are located. In those cases in which they occur in the body of the stomach, it may just be possible that the acid cells in that instance are not so widely distributed as in the average individual, i.e., those stomachs studied by the writer. In analyzing the occurrence of ulcers on the different walls, one finds that the lesser curvature suffers most. Strange to say, the acid cells cease earlier than along the other curvatures. The greater curvature seems to suffer least. and here one finds that the acid cells extend farther toward the pylorus, possibly exerting a protective function. The dorsal wall suffers next to the lesser curvature and here one notes that the acid cells extend somewhat farther than along the lesser curvature, but not so far as along the greater curvature.

Although there seems to be some relation between the occurrence of these ulcers in the different regions of the stomach and the distribution of the acid cells, the evidence is too little to be conclusive. As suggested before, in those cases of ulcer coming to necropsy, the stomach should be surveyed as in the preceding work.

The writer desires to express his thanks to Prof. Coplin and his assistants, Drs. B. Crawford and E. Weiss, for their courtesy in supplying the above material.

[1] Table II consists of the measurements of three stomachs in the preceding paper with the addition of the two recent ones.

TETANUS

Report of One Hundred Sixteen Cases at the Massachusetts General Hospital

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"ANOTHER receiv'd an insignificant wound to speak of (for it was not deep) a little below his neck behind from a sharp dart; which being taken out not long after, he was drawn and distorted backwards, as in the opisthotonus. His jaws were also fasten'd; and, if anything moist was put into his mouth, and he attempted to swallow it, it return'd again thro' the nose. In other respects he grew worse immediately. The second day he dy'd." Thus wrote Hippocrates (1) and from then until now we find throughout medical literature reports of cases, and various interesting theories, about this unusual disease. In Paris, in 1786, at the Imprimerie Royale, was published a work under the title "Projet d'Instruction sur une Maladie Convulsive, fréquente dans les Colonies de l'Amérique, connue sous le nom de Tétanos. Demandé par le Ministre de la Marine, à la Société Royale de Médecine." Here the author noted the fact that tetanus often occurred only after the wound was dry and healing was well advanced.

The following title is of so much interest that it is given in detail:

AN INAUGURAL DISSERTATION
on the
ANIMATING PRINCIPLE, or ANIMA MUNDI
of
TETANUS, or LOCK-JAW

Read and Defended at
PUBLICK EXAMINATION
Before the Medical Professors,
in the
REV. JOSEPH WILLARD, S.T.D. President
and the Governors of the University at Cambridge for the
Degree of Bachelor in Medicine
By
By FREDERICK MAY, A.M.

Dr. May divided tetanus into three groups: first, cases from punctured wounds; second, those from cold, or freezing; third, tetanus of the new-born. It was his theory that "the wounding instrument, a nail, for instance, disarranges the exquisite texture of the nerve, or tendon. If suppuration could take place, it would probably remove the offending cause. As the cause remains, the effects increase, and the disarrangement of texture creeps along the course of the nerve until it affects that whole system of nerves." He was pessimistic as to prognosis. He advised the production of "suppuration in the first instance, by an incision in the wounded part," thus . . . "the injured nerve is enabled, and solicited, to throw off the irritating injury, and recover its tone. . . . But the medicine most to be depended upon, is tobacco." This he gave by rectum, in frequent strong infusions, 2 ounces of tobacco simmered in one-half pint of water.

In 1834 The Royal College of Surgeons, London, awarded the Jacksonian Prize to Thomas Blizard Curling, for his "Treatise on Tetanus." At that early day he reported 128 cases, of which 58 recovered (8 were his own cases). He felt, however, that the prognosis was almost always unfavorable.

Before considering our own cases, we will briefly summarize the literature, though this is unnecessary to anyone who has read the valuable article of Ashhurst (23).

The bacillus of tetanus was first discovered by Nicolaier in 1883, first isolated and cultivated by Kitasato, and the first antitetanic serum was obtained by Roux and Vaillard in 1893. The bacillus is a slender rod 4μ in length and 0.3 to 0.4μ in width, readily forms spores, and is anaerobic (2). It lives in rich cultivated earth, and Lukas (3) has found it in the stools of sixteen out of seventeen horses; he thinks it is a common saprophyte in almost all of them. Also Fox, quoted by Ashhurst and John (4), has found it in the stools of 5 per cent of mankind, and 20 per cent of those working around horses. Ninni (5) cultivated bacillus tetani from the intestinal tracts of 42 rabbits and guinea-pigs, but failed to

find it in the soil of mountain regions and other places which are free from the dejecta of animals. The bacillus, once having gotten in the wound, produces the toxin which causes the symptoms, but it grows much more readily in symbiosis with certain other bacteria, especially bacillus welchii and vibrion septique, as noted by Tulloch (6). This writer believes that antibodies for bacillus welchii and vibrion septique should be included in every antitetanic serum. Tulloch (8) divides the bacillus into four types, by agglutination tests — of one hundred cases of tetanus, type I showed 41 cases; type II, 20 cases; type III, 35 cases; type IV, 3 cases. Type I showed the lowest mortality.

As is well known, the bacillus itself does no damage, but the toxin which it elaborates is the cause of the symptoms. The paths of spread of the toxin have been recently studied by Teale and Embleton (7), who have proved that it makes its way to the cord not only via the axis cylinders, but also by the perineural lymphatics. A large amount of the toxin is taken into the general circulation and from the blood vessels reaches the connective-tissue spaces and thoracic duct, but does not pass from the vessels of the central nervous system to the tissues thereof—it does not pass from the choroid plexus to the cerebrospinal fluid. The toxin, arriving at the cord, becomes impregnated in the motor cells, irritating them and causing tonic spasm of the muscles which they control.

The disease may be divided into two great categories—tetanus ascendens or local tetanus, and tetanus descendens or general tetanus. In tetanus ascendens the toxin, making its way directly to the cord, causes first an involvement of the muscles of the wounded extremity, followed or not, before death, by other general symptoms. Sawamura has proved that this form can not be caused in experimental animals if the nerves to the leg are cut before the injection of the toxin. Before the introduction of antitetanic serum as a prophylactic, local tetanus occurred in about 1.1 per cent of the cases; after its preventive use this form occurs in 16.5 per cent (9). Tetanus descendens is by far the more common form; in this the involvement of the central nervous system brings about first of all symptoms in the muscles of the jaws and neck, followed by more or less extensive involvement of the rest of the body. In their valuable monograph Courtois-Suffit and Giroux (10) mention four cephalic types, viz.:

(1) Cephalic form without paralysis; (2) cephalic form with paralysis of facial nerve; (3) cephalic form with paralysis of motor nerves of eye; (4) cephalic form with paralysis of hypoglossal nerve.

They speak also of the very rare localized "abdominothoracic" form, in which the lower half of the trunk is so tense that it seems transformed into marble. Especially in the past there has been much discussion of "tetanus neonatorum," and a recent case is reported by Renton (11), in which the site of inoculation was undoubtedly the umbilicus; also another in a ten days' infant by Egnia (12).

The bacillus of tetanus grows much more rapidly and virulently if there is a foreign body retained in the wound (13). This fact has been well recognized, especially since the past great war, and makes the indications for removal of the foreign body so much the greater. The muscles most frequently involved appear to be, first, the masseters, then the posterior cervical muscles, those of the anterior abdominal wall, the spinal muscles in the dorsal and lumbar region, and lastly the flexors of the hip, knee, and ankle joints (13).

In addition to the usual occurrence of tetanus following wounds, it occasionally horrifies the surgeon by occurring in well-appointed hospitals after ordinary surgical operations. One of our cases occurred 10 days after an operation for acute gangrenous appendicitis—culture of the discharge and the stools was negative, and the cause was never ascertained. Recently there have been nine deaths from this postoperative incidence in the Madrid General Hospital (14), in patients who were already convalescent or who had been discharged as cured. Careful examination of all materials used in the operations failed to show anything, but it was thought that the germs were in the catgut. This postoperative form has been carefully studied

by Huggins (15) who advocates withholding green vegetables for several days before operations involving the gastro-intestinal tract. In the recent war the Surgeon-General of the United States ordered a prophylactic injection of antitetanic serum before every rectal operation. In addition to the above, it is to be noted that tetanus may come from wounds so slight and so superficial that they are hardly noticeable, and it is not at all unheard-of to have a clear-cut clinical case, and yet be quite unable to find the focus of the disease. In one of our cases trauma was absolutely denied, though we found an old crusted lesion on one leg. In the war tetanus occurred in cases of "trench-foot," a circulatory disorder due to prolonged exposure of the feet to wet and cold; in which disease, in its advanced stages, blisters and even local gangrene were superimposed on great œdema. Prophylactic serum was given in all these cases. A number of fatal cases occurred some years ago following the injection of diphtheria antitoxin; evidence was brought forth which showed that a horse supplying the antitoxic serum had died of tetanus shortly after the bleeding which furnished the fatal serum, but at the time of the bleeding no symptoms of tetanus had been noticeable (2).

It must be borne in mind that the character of the disease is usually much modified if the serum has been used as a prophylactic measure. In the first place the incubation period is much prolonged. Sir David Bruce, in an analysis of 1,426 cases, found that the usual incubation had been lengthened to 39.5 days (16). The occurrence of local tetanus is, as noted above (9), about fifteen times as common. Furthermore, the severity of the disease is much less, and the mortality correspondingly lower; the mortality among British troops at the beginning of the war averaged 57.7 per cent, and in 1918 it had been lowered to 26.0 per cent (16). A few observers have criticized the use of antitetanic serum in this way, but its value has been clearly demonstrated to be so great, and its dangers so slight, that the arguments against it fade into insignificance.

Applying this knowledge to our own civilian surgery, it may be said that a preventive injection should be given in any case, however slight, in which there is any reason to fear tetanus. This applies chiefly to dirty punctured wounds of the feet or hands, severe lacerating wounds of any part of the body, and especially compound fractures. Its value varies directly with the lapse of time between the receipt of the injury and the time of administration—the sooner it can be given the better. The antitoxin in the blood is all eliminated in about 10 days, and in severe wounds a second dose should be then given, and to be doubly sure, a third dose in about 20 days.

The recent war has demonstrated that a secondary operation, even months after the original wound, may be the means of causing tetanus by stirring up to renewed activity spores which have been lying dormant in the tissues. Such cases are not rare (17), and the second operation should always be preceded by a prophylactic injection; the same would apply in civilian as in military life.

Before proceeding to the serum treatment of the disease, it is well to mention other methods, though I shall pass over them briefly as they are secondary in importance. Carbolic acid, in hypodermic and intra-muscular injections, as first suggested by Baccelli, and later tried out by numerous workers, has proved to be of no marked benefit, and it is doubtful if it is worth trying. Camus (18), as a result of his experiments on dogs, says that though it may have a depressant and anæsthetic action, it has no effect in stopping the progress of the disease. Magnesium sulphate, since first suggested by Meltzer, has been thoroughly tried out, though this again has no specific action, being used merely as a depressant. The usual method has been to give it intraspinally, about 1 cubic centimeter of a 25 per cent solution for every 25 pounds of body weight. Some cases have gotten well, whether because of, or in spite of this, one can hardly say. It has not recommended itself highly to most observers, and is not indicated as a routine measure. Porter and Richardson (19) in two cases in this hospital isolated the bacillus from inguinal glands, the wounds being on the foot; and they say that, this being so, certain cases will arise in which the removal

of lymphatic glands will be indicated to ensure recovery. Lumière (20,) has advised the use of persulphate of sodium intravenously—it is given intravenously in 20 cubic centimeter doses of a 5 per cent solution, every morning and every evening. Its action is not specific for the toxin, and it has not been used enough, as yet, to enable one to pass judgment upon it.

The proper treatment of the wound is the *sine qua non*, and without it every other form of therapy is in vain (22). The principles of treatment may be laid down as:

1. Sterilization of the part;

2. Thorough opening of the wound in its whole breadth and depth;

3. Débridement — complete excision of every scrap of dead or infected tissue;

4. Sterilization of the wound;

5. Measures to keep it open. It must not be "packed," though gauze, preferably soaked in hydrogen peroxide, may be laid gently in it. It must not be tightly bandaged. Anything tending to close the wound, and shut out the air, must be avoided. The dressing should be renewed very frequently.

The use of the antitoxin opens up an almost limitless field for discussion, and we can do no more here than give general conclusions. On theoretical and experimental grounds we may state that the antitoxin does not pass to the central nervous system via the blood vessels, axis cylinders, or perineural lymphatics, nor does it pass to the cells of the spinal cord from the cerebrospinal fluid, when injected intraspinally (7). It apparently acts simply by neutralizing the toxin being formed, and that already circulating in the blood (22). Sir David Bruce, whose knowledge of the disease is probably greater than that of any other person, says that the antitoxin has no power of neutralizing toxin already fixed in the nervous system, and that if a fatal amount of toxin has been absorbed, no amount of antitoxin will save the patient's life (24). Roux and Vaillard agree with this (10). Dean (13) thinks that antitoxin injected intraspinally would probably be absorbed by cranial sinuses and meningeal veins, and find its way into the circulation rather than into the cells and pericellular spaces of the central nervous system. He found that 12 hours after intravenous injections of 30,000 units, both the cerebrospinal fluid and the blood contained an ample amount of antitoxin.

As to the method of administration, we at once run into argument. In 472 cases, in each of which only one route was employed, the British War Office (25) reports results as follows:

	Cases	Deaths	Mortality percentage
Intrathecal only	90	63	70.0
Intravenous only	31	23	74.1
Subcutaneous only	205	140	55 0
Intramuscularly only	86	34	39.5
	472		

Their conclusions are that the intraspinal method is of value chiefly in the very early stages; the intravenous carries with it too much danger of anaphylaxis and is not recommended; the subcutaneous and intramuscular have definite points of value. They do not, however, dictate any definite rules for administration.

Golla (26) as a result of experiments on cats and rabbits concludes that the intraspinal and intravenous methods are far superior to the subcutaneous. Ashhurst (23), Sir David Bruce (16), Sherrington (28), Nicoll (27), and most others advise large doses intraspinally, supplemented by other methods—mostly intravenous—though Sir David Bruce favors subcutaneous and intramuscular (16). We may quote the British War Office (25): "Attempts have been made to draw useful conclusions as to the best mode of administering the antitoxin, and the most suitable methods of dosage, but the interpretation of the results has proved extremely difficult, and we are not in a position to lay down precise rules on the subject. Three cardinal principles, however, are clear; the antitoxin treatment must be started immediately after the appearance of the first suspicious sign of tetanus, the dosage of the antitoxin must be high, and its use must be maintained well into convalescence."

Intracranial and subdural injections have been used in a good many cases, the most recent report and résumé being that of Eberle (29), but this method has not proved

itself to be of enough value to warrant its use. Injections directly into the nerve leading to the wounded part have been tried. This is a form of administration which cannot be advised as a routine measure, but cases may arise in which it would seem indicated.

The untoward effects of antitoxin are twofold:—first, the serum sickness, and, second, anaphylaxis. The serum sickness comes on in from 8 to 15 days after administration, is characterized by urticaria, general pains, moderate temperature, is present in greater or less degree in practically every case, and is in itself of no serious moment. Anaphylaxis, on the other hand, is very dangerous, though rare, and ordinarily does not occur unless about 2 weeks or more have supervened since the first injection. It comes on during the injection, or immediately after, and is characterized by collapse, changes in pulse and respiration, and at times coma. Its dangers are greater if the antitoxin is being given intravenously, as in this way the patient may be overwhelmed by a fatal dose before the danger signals are enough to give warning. In cases where anaphylaxis is feared, a test may be previously made by giving 1 cubic centimeter of the antitoxin subcutaneously and watching for reaction. One of our cases went into collapse from anaphylaxis while being given an intravenous dose, 12 days after the initial injection, but recovered on immediate cessation of the procedure. From the general experience of the great majority of men, it may be said that the danger of the occurrence of anaphylaxis, in the general run of cases, is very remote, and the objections to intravenous injection on this score are not valid.

REPORT OF OUR CASES

Since 1872 there have been, in the Massachusetts General Hospital, 116 cases of tetanus. During the past few years most of the cases have been under the personal supervision of the writer. The total mortality of these 116 cases has been 69.9 per cent. Antitoxin was first used in 1896; first, Gibier's preparation — a powder dissolved in water; next, Pasteur's antitoxin, and, later, that prepared by the state board of health. Previous to this our statistics include 20 cases, in which the mortality was 80 per cent; demonstrating that a certain number of cases of tetanus are going to recover, even if they never have specific treatment. Since 1896 we have had 96 cases with a mortality of 67.7 per cent — a drop from the preceding figure, but not a great one. However, as we follow the cases up to the present time, the mortality gradually gets less and less, as noted in these figures:

	Cases	Mortality percentage
Since January 1, 1900	87	65.1
Since January 1, 1910	48	37.5
Since January 1, 1916	25	52.0
In 1921	5	40.0

Thus we see that for some reason or other the mortality has steadily decreased, and we believe this is due to more intensive and intelligent administration of antitoxin. Of the last 5 cases, 1 had completely recovered from her tetanic symptoms, only to die of a bronchopneumonia. Of course this must be recorded as a tetanus death, but actually the tetanus had been cured, leaving the patient in such a weakened condition that she could not overcome the pulmonary involvement.

In all the cases since 1896 antitoxin has been used, the amount and method of administration being modified and perfected, if that word may be used, as our experience has increased. Three of our cases were treated by trephining the skull with direct subdural injection—all of these died. Three cases were treated with magnesium sulphate in conjunction with antitoxin, and of these three, two died. We could not see that the drug exercised any valuable therapeutic action. In two cases tetanus bacilli were isolated from the inguinal glands.

It has been generally accepted that the shorter the incubation period, the worse the prognosis, and that with an incubation under 10 days the outlook is of necessity very grave. We do not feel that this view is entirely justified. Of our recoveries the exact incubation period was noted in 27 cases, and in 10 of these it was under 10 days as follows:

	Recoveries
Incubation, [illegible] days	1
Incubation, 5 days	3
Incubation, 6 days	1
Incubation, [illegible] days	2
Incubation, 8 days	2
Incubation, 9 days	1

Thus it is clear that just because the incubation is short, the outcome is by no means hopeless; and the case should be taken in hand with all the more vigor.

Our last 5 cases, of which 3 recovered, are the most interesting ones, and brief reference will be made to them here.

CASE 1. A. K. School-girl, age 16, admitted December 16, 1921. Punctured wound of foot. Incubation of tetanus 7 days. Duration of the disease before entrance 24 hours.

The first symptoms were sore throat and stiffness in jaws and neck. Examination revealed a small slightly infected wound on sole of right foot; trismus; spasm of neck and abdominal muscles. Cultures of wound and spinal fluid negative for bacillus tetani.

Treatment:	Around wound	Intravenously	Intraspinally
December 16.....	1,500 units	20,000	10,000
December 17	"	50,000	10,000
December 18	1,500 units	50,000	10,000
December 19	"	50,000	"
December 20	"	30,000	"
December 21.....	1,500 units	30,000	5,000

Total antitoxin 269,500 units.

The wound, on entrance, was thoroughly opened and cleaned, swabbed with iodine, and gauze soaked with hydrogen peroxide lightly laid in, and frequently changed. No bandage. She was given luminal in doses of 1 grain every 3 hours. On the 21st the tetanic symptoms and signs were rapidly receding, and recovery was looked for, but on the 22nd the temperature was higher, respiration was rapid and labored, and a diagnosis of bronchopneumonia was made. The spasm had let up to a degree that she was able to sit up with a head rest, and the neck was relaxed. She was taking fluids well by mouth.

On December 23, all tetanic signs had disappeared save for slight stiffness in jaws. On December 24 she became cyanotic, and there was dullness at both bases. In spite of all attempts at saving her she died December 26 at 3.02 a.m

This was a case which can fairly be said to have died, not of the tetanus *per se*, but of its complication.

CASE 2. E. T. A man, age 44, hostler, admitted April 22, 1921. Lacerated, infected wound over right tibial tubercle, from a horse kick. Incubation 13 days; duration before entrance, 4 days. First symptom—stiffness in jaw muscles. On entrance his wound was opened and cleaned out, but on the second day, the infection apparently having become worse, it was again, and more thoroughly, laid open and cleaned. After 2 days of extreme tonic spasms, with typical risus sardonicus, he began to improve. He was given in all 180,000 units of antitoxin, intraspinally, intravenously, and around the wound. He was given luminal, 3 grains every 3 hours. Spinal fluid and wound negative for bacillus tetani.

This case was not extremely virulent, but in the first 24 hours after entrance he became very much worse, and would probably have died without effective treatment. This was the first case in which we used luminal, and its dosage was high, but it had no untoward effect and we believe that it was of value.

CASE 3. A little girl, D. K., age 4, admitted August 16, 1921. Incubation not determined, as the exact lesion could not be ascertained—she had had numerous mosquito bites, which she had scratched. It was a typical tetanic case, never very severe, and recovered after the administration of 55,000 units of antitoxin, given as follows:

	Intraspinally	Intramuscularly	Intravenously
August 16	3,000	10,000	"
August 17	"	15,000	"
August 18	"	"	17,500
August 19	"	"	5,000
August 20	"	"	5,000

CASE 4. C. C., a school-girl, age 7, admitted July 23, 1921. Punctured nail wound of foot. Incubation 8 days, duration before entrance, 2 days. A severe case, with opisthotonus and generalized muscle spasm. Total amount of antitoxin 141,000 units, given as follows:

	Intraspinally	Intravenously	Intramuscularly
July 23	3,500	8,500	"
July 24	"	11,000	2,000
July 25	"	22,000	"
July 26	"	15,000	5,000
July 27	"	10,000	"
July 28	"	7,000	"
July 29	"	10,000	"
July 30	"	10,000	"
July 31	"	7,000	"
Aug. 1	"	"	10,000
Aug. 3	"	10,000	"

She was given luminal 1 grain every 3 hours. On entrance the wound was treated in the routine manner.

This was a severe case, in our opinion saved by the treatment.

CASE 5. K. H., a school-girl, age 7, admitted October 5, 1921, with an infected wound of the upper arm, received 3 weeks previously. Onset of tetanus 36 hours before entrance. Assuming the tetanus bacilli to have gained entrance at the time of the original wound, the incubation would be just under 3 weeks, but the virulence of the case makes us believe that the specific infection occurred at some later date, and the incubation period is considered doubtful. She entered the hospital at 1.25 a. m., with severe symptoms, the case seeming almost hopeless from the start. The wound was cleaned

out, and on that day she received 5,000 units intraspinally, 4,500 around the wound, and 40,500 intravenously. The next day, October 6, she received 40,000 intravenously, but failed rapidly, convulsions becoming more violent and of longer duration. She died at 11.22 p.m., having received 90,000 units.

This is one of the extremely virulent cases, which our present knowledge and methods have not yet enabled us to combat successfully.

Given a hundred cases of tetanus, a certain number, perhaps twenty, will get well anyway, with ordinary symptomatic treatment, and without antitoxin. A certain number, to which the author will not attempt to give a figure, will, in spite of the best treatment which our present knowledge enables us to give, die. Between these two groups lies the middle class of those who will die or get well according to their treatment, and by that treatment we mean the proper care of the wound, the intelligent use of sedatives, and the prompt, well-directed, and repeated use of large doses of antitoxin. The problem which must be solved if we would cure more cases is that of getting the antitoxin into contact with the toxin which has already invaded the nervous system. We are in the position of a general with a large, well-equipped army, who suddenly sees the enemy make a determined drive at some objective, and rapidly entrenches himself; the general launches his nearest troops in counter-attack, and brings up his reserves, but he has been unable to find out the best routes of advance, his troops wander and do not get at their own objective, and by the time he cuts the enemy's line of communication the position which he wanted to save has been destroyed. These routes we have not yet learned.

CONCLUSIONS

1. Prophylactic injection of antitoxin should be given, in civilian as well as war practice, in every case in which there is the slightest possibility of the development of tetanus.

2. Excision and débridement of the wound is the first essential. The wound must then be kept open—neither packed tight nor bandaged tight.

3. The use of magnesium sulphate and carbolic acid is of doubtful value.

4. Sedatives must be used as indicated, and though our experience with it has not been extensive, we believe luminal is a valuable drug and advise its use.

5. We advise antitoxin in large doses by the intraspinal and intravenous route, with small doses into the tissues around the wound.

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DEPARTMENT OF TECHNIQUE

BONE GRAFTING

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BONE grafting is indicated when it is necessary to stimulate osteogenesis in tuberculous joints, to repair injured bone, to replace bone destroyed by infection or malignancy, to supply congenitally absent bone joints, to correct congenital deformities, and to close bone foramina or trephine openings in the skull.

The first successful bone transplantation was done by Merrem in 1809. This work was done upon animals. Later, Ollier, in extensive work on both animals and man, found that fresh bony tissue with the periosteum intact gave the most successful results. This was in 1858. Hence we see that bone grafting is not new. Yet the men foremost in bone surgery today are not yet agreed as to just what takes place when living bone is transplanted: whether the whole graft lives, whether the osteoblasts are sent out by the periosteum or endosteum, or both, or whether the graft acts merely as a bridge and the osteoblast proliferates into it from the ends of the host bone. However, it is conceded by all that it is best to use an autogenous graft with the periosteum and endosteum, when possible.

Among the various kinds of grafts we have homoplastic, heteroplastic, and autogenous grafts; boiled bone; ivory pegs; screws; wire and metal plates. In this article I will discuss only autogenous grafts. Regarding foreign bodies in bone work, I would say only this that, in nearly all cases, to obtain union it is necessary ultimately to remove the foreign bodies.

Autogenous grafts are living grafts taken from the individual who is being operated upon. The autogenous graft is far superior to all others. Albee claims that union is secured in every case where the autogenus graft is used. In using such grafts it is best to have the periosteum and endosteum intact.

Since it has been the experience of most surgeons that any but the autogenous graft is apt to cause trouble as it acts as a foreign body and it is ultimately necessary to remove it to obtain union, and in view of the fact that under the proper technique we obtain 100 per cent cures in autogenous grafting, there really is but *one* operation of choice—the autogenous graft operation.

I shall consider only one form of graft—the intramedullary. The intramedullary graft is not so universally used as other grafts, but, in my opinion, we obtain just as good results with it and the technique of operation is more simple and the operation more quickly done. The real purpose of this article is to explain why the intramedullary method has been discarded by most surgeons and to present a technique which has given the desired result.

The method of intramedullary grafting that I am using is one that I have worked out myself, and if a similar operation has been described I have failed to see any mention of it in any journal or book on bone work. I have now done 75 intramedullary graft operations and have secured union in each case without any complications.

The technique of the intramedullary graft operation as used by Albee and other surgeons doing

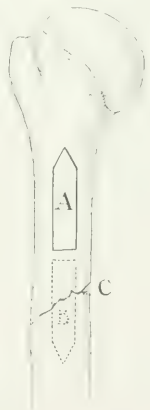


Fig. 1. *A*, Intramedullary graft cut out with Albee electric saw ready to be removed; *B*, intramedullary graft in medullary canal in proper position; *C*, line of fracture.

bone work may be described as follows: A small autogenous bone peg is cut, and one end of the peg is inserted into the medullary canal of the proximal end of the fractured bone. The distal end of the fractured bone is then tilted so as to insert the other end of the peg into the medullary canal of this, the distal, end of the fractured bone. This is rather a difficult thing to do, especially if two bones are fractured, as the tibia and fibula or the radius and ulna. Albee states that he has fractured the fibula while trying to insert the intramedullary graft into the tibia, and for this reason he has given up the use of the intramedullary graft. Also the graft is quite often broken, while attempting to insert it. So it seems that this technique is unsatisfactory and should be discarded.

The technique which I have worked out is as follows: The skin incision should not be made directly over the center of the bone to be operated on, but a little to one side. The fractured bone is exposed in the usual manner. The graft is taken from the fractured bone, either above or below the line of fracture, depending upon which would be the more practical, considering the location of the fracture, muscles, blood vessels, and nerves. If the fracture is an old ununited one, the fibrous scar tissue is cut away and the ends of the bone freshened by cutting off the fractured ends until the healthy bone is reached. If the fracture is a recent one, the muscle or any surrounding tissue that is between the ends of the fractured bone, is, of course, removed. One end of the exposed fractured bone is now tilted up so as to obtain the exact width of the medullary canal, and the twin saws of an electric bone outfit are set the exact width of the canal. With a knife the graft is outlined, cutting through the periosteum. The graft should be about 4 or 5 inches long and should not extend closer than within 2 inches of the fracture. The graft is cut with the twin saw. The ends, one of which is blunt, the other pointed, are cut with a single saw. The graft, which includes the periosteum and endosteum, is now lifted out. The pointed end is inserted into the opening from which the graft has been cut, is pushed into and down the medullary canal past the line of fracture, into the medullary canal of the other end of the fractured bone, so that 2 or 3 inches lies in the proximal and a similar length in the distal part of the fractured bone, thus bridging the fracture.

As the graft is the exact width of the medullary canal, it fits snugly and holds the fractured bones firmly and in good position. As the graft has both the periosteum and endosteum it makes no difference from which the osteoblasts proliferate.

If, by mistake, the graft has been cut too narrow and does not fit snugly in the medullary canal, drill 2 or 3 holes through the entire bone going through the graft, and pass kangaroo tendon through the holes, tying the graft in place.

All hæmorrhage is stopped, the muscles, fascia, and skin are closed in the usual manner, and splints or plaster are applied.

The after-treatment is the same as after any other bone transplantation.

It is not my idea that the intramedullary graft should be used in all cases where a bone transplant is indicated, as in many instances the inlay, peg, or other form of bone transplant is more applicable.

In fresh fractures operation should be done in 5 to 15 days, unless the fracture is compounded or infected. If infection is present operation should be delayed until all infection has been overcome, as it is difficult to obtain union in the presence of infection.

Following are a few case reports which show the results after operation in which my method of intramedullary graft was used.

Case 1. J. R., age 17. Ununited fracture of 3 months' standing, upper third of right tibia. Operated on April, 1918. Muscle and scar tissue were found between ends of fractured bones. The tissue was removed, the ends of the bone freshened, an intramedullary graft inserted, and the leg put up in plaster cast. Result: perfect union and boy returned to work 7 weeks from operation.

Case 2. W. B., age 34. Fractured left femur, middle third. Patient brought into hospital same day of injury, May, 1919. Leg was put up in extension for 10 days, with ends of bone still overriding. We decided open operation was necessary for complete reduction. Operation eleventh day after injury: intramedullary graft operation done, and leg put up in plaster cast. The cast was removed at end of sixth week, and patient walked at end of twelfth week. He has absolutely no shortening of leg.

Case 3. V. T. Y., age 40. Ununited fracture of right radius 2 inches above wrist, 4 months' standing. The ulna was fractured at same time but had united. The lower end of radius was displaced and was bound down by a fibrous union to the ulna. The upper end of radius was free. Intramedullary graft operation was done April, 1917, and a plaster cast applied. Result: perfect union and patient was able to resume work 8 weeks after operation.

Case 4. E. N., age 28. Right humerus fractured middle third, February, 1917. Four attempts were made to reduce fracture and X-ray showed each attempt to be a failure. An open operation to reduce fracture was done 10 days after injury. An intramedullary graft was inserted and the arm put up in plaster cast. Result: perfect union and patient returned to work 8 weeks after operation.

DAMPER GASTRO-ENTEROSTOMY

By J. CHRISTOPHER O'DAY, M.D., F.A.C.S., Honolulu, Hawaii

GASTRO-ENTEROSTOMY, performed as it usually is with clamps, often fails because of the sequelæ such a procedure invites. We refer in particular to postoperative hæmorrhage and those subsequent ulcers of the stomach that the pressure of the clampblades has been at times seemingly responsible for. Another postoperative disturbance that may give both patient and surgeon anxiety is the postoperative vomiting induced by regurgitated bowel contents. While such vomiting is due to the character of the anastomosis rather than to the use of the clamps, it is, nevertheless, fraught with dangers capable of thwarting the purpose for which the operation is originally undertaken.

Of all the postoperative sequelæ, however, hæmorrhage is to be feared the most because it is not likely to begin until after the patient has been returned to bed where, in the absence of the surgeon, it is not recognized until loss of blood has, stealthily, carried him into the realm of shock, perhaps death. Indeed, it was just such an occurrence that prompted Robert C. Coffey to work out his no clamp gastro-enterostomy.

While the clamps we had always used were of very light and flexible blades, two of our cases developed ulcer of the stomach in that portion of the mucosa where the blades had pressed during the operation. Because of these two unwelcome sequelæ, the Coffey procedure attracted our interest. We soon realized, however, that an unfair risk would be unjustly imposed, should it be attempted on a fellow-being without first having mastered its every detail on a number of the lower order of animals. Following the advice of Coffey, we carried out a number of such experiments, but, before doing so, we had several opportunities of seeing the operation performed by its author.

Finally after we had sufficient experience to warrant our applying this splendid procedure to our regular work, we soon found that the entire period of postoperative convalescence was markedly free from all the disagreeable features of the old clamp technique. The vomiting we attributed to the welt which the second or through-and-through line of sutures produced, and when the "Coffey welt," of his no clamp gastro-enterostomy, was known to be the moderator of the intestinal regurgitation, the suggestion came to us of converting the welt into a damper by enough additional sutures to fuse the half of the jejunal circumference to the wall of the stomach.

After a number of experiments, the operation described here was perfected. Those familiar

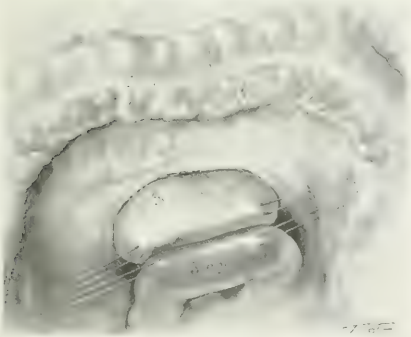


Fig. 1. The stomach is made to herniate through the transverse rent in the mesocolon, the jejunum is rotated downward and the traction loops in place.

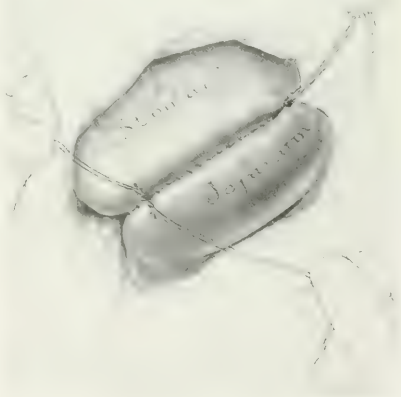


Fig. 2. A seromuscular stitch brings the stomach and the jejunum together and the traction loops are tied over the seam.

Fig. 3. The second or through-and-through line of suturing, sewing to the internal margins of the traction loops, is begun in such a manner that corresponding portions of stomach and bowel are lifted into two distinct welts which come together and cover the first line of approximation.

Fig. 4. Nearly one-half of the circumference of the jejunum is fused by suture to the posterior wall of the stomach. The line of stitching that shows is a seromuscular one. The second, or through-and-through, line is directly beneath it. This stitch completes the construction of the damper. When the opening into the stomach and bowel has been made it is covered by sewing the two inner free edges over it and thus making the mucous covering of the damper continuous.

with the no clamp method spoken of above will readily recognize the modification we have given it, and while the regurgitation of the bowel-contents was the thing we set out to prevent, unwittingly another of the disagreeable post-operative sequelæ was, by the construction of the damper, prevented, namely postoperative jejunal ulcers that always involve that portion of the jejunal mucosa where the chyme jets straight through the unguarded opening of a clamp made anastomosis.

Properly performed then, we are convinced that damper gastro-enterostomy will entirely do away with all those menacing postoperative features of the earlier operation: retarded hæmorrhage, ulceration of that portion of the stomach wall pressed by the blades of the clamps, regurgitation of bowel-contents, and ulceration of the jejunal wall where it is forcibly struck by the chyme.

TECHNIQUE OF OPERATION

The rent in the transverse mesocolon is made parallel to the transverse colon instead of at right angles to it, and the stomach is allowed to herniate until the vessels of the lesser curvature have been brought into view. The rent is best effected by tearing gently with the fingers, for in this way adjacent vessels will be drawn, intact, to the lateral margins and conserved, while at the same time the artery colica media is protected against the likelihood of injury.

With the posterior wall of the stomach thus exposed, the lower margin of the rent may be tacked to it by three or more interrupted sutures. The traction loops, penetrating the four coats of the gastric wall, are then placed in such fashion that toward the greater curvature surface sufficient to fuse the half of the jejunum's circumference will be insured.

The jejunum is then sought and brought forward in the usual manner, and when the duodenojejunal junction has been identified, the no-loop portion is made to parallel the line of the traction and then rotated downward until its mesenteric border becomes adjacent to the stomach. Just above this mesenteric border of the jejunum the second pair of traction loops are placed, but it is well to bear in mind that, owing to the valves of Kerkring (*plicæ circulares*), the jejunum, at rest, especially at its no-loop portion, is so contracted that unless the loops be placed closer together than they had been in the stom-

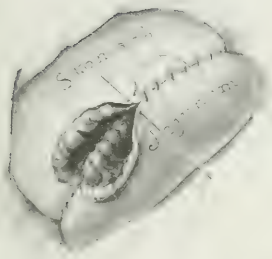


Fig. 5. Partially schematic to show damper rising, partition-like, between the cavity of the stomach and that of the jejunum.

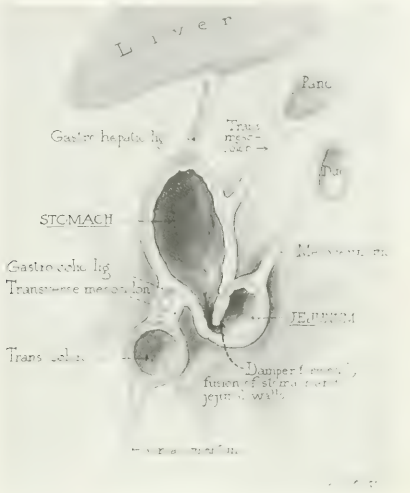


Fig. 6. Diagram showing relation of viscera when operation is complete.

ach, equidistance will not obtain when the two viscera are drawn together for stitching. The loops in the jejunum should be no farther apart than the two-thirds of the distance between those in the stomach.

By gentle traction, the assistant then draws two ridges of the viscera together; through these the sero-muscular line of suturing is carried. Beginning about the half of an inch outside the loops, the stitching is carried toward and between them. When finally it emerges from between the second pair to a point about the same distance beyond, each set is tied snugly over the seam. The needle is put aside, still threaded, until the finishing stitch of the anastomosis is to be made.

The second suture will include all the coats of both stomach and bowel. It is placed in the following manner: The needle is plunged into the jejunum about the third of an inch away from the first row of stitching. With its point within the lumen it is turned toward the stomach to emerge at a point about midway to the seam, then over the seam to enter the stomach and then out from the stomach at a point directly in line with the point at which it first entered the bowel. A tie will draw two distinct welts in each and facilitate the completion of this second or through-and-through line of suturing.

Like the first, the third suture line is seromuscular. When it has been completed, the opening into the two viscera is made. Mucosa of stomach and that of jejunum approximated along the crest of the damper completes it. From this point on, the operation is completed as it is in the clamp operation with but two rows of suturing. Beginning at the opposite angle from which the first line was started, a through-and-through stitch is carried to the point at which the first needle was put aside. Here again it is taken up and buries the stitch just taken beneath a seromuscular one across to the point where a free end designates its beginning. A knot with the free end completes the operation.

THE PROSTATIC PROBLEM[1]

By DAVID W. MacKENZIE, M.D., F.A.C.S., and MAGNUS I. SENG, M.D., Montreal, Canada
The Department of Urology, Royal Victoria Hospital

THE purpose of this paper is neither to draw comparisons between the various methods of performing prostatectomy nor to laud any particular method to the exclusion of all others, but rather to bring before you some of our efforts to simplify the treatment of this common condition.

Each method has, at the proper time and in the proper hands, its own peculiar virtues and uses, and in a well-equipped department of urology, with an efficiently trained personnel, such as are seen in the large hospitals of today, no one method of dealing with the question of prostatectomy should be adhered to to the exclusion of all others. We have come to realize in our teaching, both under-graduate and graduate, that the exigencies of general medical or surgical practice do not allow the time or afford the opportunity for mastering the techniques of the various methods of performing prostatectomy.

With this in mind, we have attempted in the past few years in the Department of Urology of the Royal Victoria Hospital to perfect, and above all to simplify a method of prostatectomy which will give the safest and most satisfactory results. The operation that fulfills the three requisites of simplicity in management, ease and safety in performance and satisfaction in the final result is, we believe, the so-called two-stage suprapubic prostatectomy. Below will be described the routine, technique, and management used in this class of cases in the Department of Urology in the Royal Victoria Hospital.

On admission to the Department a searching history is taken with particular elaboration of the symptoms referable to the genito-urinary system. These symptoms are frequency, dysuria, hæmaturia, and alteration of the urinary stream. The frequency of urination may be day or night; more often it is nocturnal. Frequency was noted in 90 per cent of our cases and it formed the first symptom noted by the patient in 78 per cent of the cases. Painful urination is at times a prominent symptom.

Contrary to the almost universal belief hæmaturia is not so prominent a symptom in carcinoma of the prostate as it is in prostatism—the benign prostate. This is caused by the congestion and erosion of the prostate and vesical neck in prostatism.

A prominent symptom nearly always, is alteration of the urinary stream. The patient notices that for some months or even years the urinary stream has gradually become smaller and that he has to strain to start his flow. He has also since this began, become the victim of hæmorrhoids or hernia. This condition continues until one day after catching cold or after some other indisposition he is unable to void at all. He has his first attack of retention and he requires to be catheterized. He may recover and he may have several such attacks, from all of which he survives. But sooner or later he will not recover.

Always there is close questioning of the patient regarding his general health—appetite, sleep, headaches, constipation, bad taste in the mouth and dry tongue, torpor, loss of weight and strength—all pointing to a general intoxication due to impaired renal function.

The onset of symptoms varies considerably. Usually it is over a long period of time. The average onset of symptoms before admission, in our series, was 5½ years, the longest 32 years. It may be quite short, especially in the early cases.

Next, a complete physical examination is made to include exploration of the urethra, determination of prostatic obstruction, amount of residual urine and estimation of the extent of prostatic involvement, per rectum. Not unimportant is the estimation of the blood pressure, which not infrequently is quite high and falls 20 to 30 millimeters of mercury upon relief of retention. Repeated urinalyses are done: 90 per cent of these cases of prostatism show the presence of infection by pus and blood in the microscopic specimen, often the specific gravity is low.

Then comes the repeated estimation of the renal function by the phenolsulphonephthalein test:

	Percentage
Normal average: first hour reading....	50 to 60
Normal average: second hour reading.	25 to 30
Normal average: two hour reading...	75 to 85

In cases of prostatism our findings have been:

	Percentage
On admission average two hour reading	55
After drainage average two hour reading..	52
On discharge average two hour reading...	57

The urea, uric acid and creatinine contents of the blood are taken at intervals coincident with the estimation of the phenolsulphonephthalein tests. The findings here, for the most part, parallel those of the latter. The normal contents of the blood may be said to be:

Blood urea 0.35 gram per litre of blood.
Blood urea nitrogen 12 to 18 milligrams per 100 cubic centimeters of blood.
Uric acid 1.5 to 3.5 milligrams per 100 cubic centimeters of blood.
Creatinine 0.7 to 1.5 milligrams per 100 cubic centimeters of blood.

Blood findings in cases of prostatism:

	Percentage
Cases showing only blood urea retention	46
Cases showing blood urea and uric acid retention	24
Cases showing blood urea, uric acid and creatinine retention	40
Cases showing normal blood urea, uric acid and creatinine content	26

The blood urea is the first element of the blood to be affected, followed by uric acid, with creatinine the last to be elevated beyond normal limits; when this last occurs it is an indication of severe degree of impaired renal function and indicates a poor or at least guarded prognosis. This is particularly true when the creatinine content remains fixed or moves but little toward the normal limit even after prolonged catheter or suprapubic drainage. The phthalein test is the simpler and gives a quite satisfactory indication of the functional condition of the kidneys. Just here it is well to state that though we consider the laboratory findings of prime importance, not less do we estimate the clinical and physical condition of the patient. Each must supplement the other, else the surgeon finds he is going astray.

Every case is roentgenographed for the presence of stone, vesical or renal. Cystoscopy is performed in selected cases to determine or verify presence of stone, extent of intravesical enlargement of the prostate, and presence of vesical diverticula.

Should there be residual urine, which occurs in 80 per cent of the cases, either an indwelling catheter is placed in the urethra, when tolerated, or the patient is catheterized every 8 hours until such time as suprapubic cystotomy is performed. The average drainage in this manner has been 5 days; however, suprapubic drainage can be done at any time, the sooner the better. It is freer than catheter drainage and less likely to go wrong or lead to the annoying complication of epididymitis.

THE SUPRAPUBIC CYSTOTOMY

Our routine wash-up has been soap, water, and alcohol. The bladder is filled comfortably with warm boric solution or distilled water. Local anæsthesia, anocaine 1 per cent, novocaine 1 per cent for the skin and ½ per cent for the deep tissues, is used. Infiltration is done slowly, care being taken that there is no pain nor shock. The virtue of the local anæsthesia is that it can be done leisurely; there is no drain on the already much overworked kidneys. Infiltration can be done with the patient anywhere, in his bed or on the kitchen table. The skin and deeper tissues are infiltrated from just below the umbilicus to well onto the symphysis pubis. A median suprapubic incision is made along the line of infiltration. This gives a long incision and it is purposely so, so that we may see and handle easily those structures we have to deal with. The rectus sheath is incised practically the length of the incision; the recti are separated and retracted. The peritoneal fold with its layer of preperitoneal fat is infiltrated just at the symphysis pubis, and by careful dissection is retracted upward. Not infrequently this fold of peritoneum is low and may be adherent to the pubic bone which brings forcibly to mind the folly of suprapubic puncture with trocar and cannula. The fold is retracted as high as possible, during which the bladder becomes exposed. The bladder is infiltrated at its highest point, incised, and the contents evacuated by suction; and then explored for calculi, and to determine the exact size of the gland and nature of the obstruction. At this point we have been in the habit of putting in what is called an "anchoring suture." Heavy catgut on a fair-sized curved needle is used. The suture is placed at the level of the vault of the bladder and goes through the rectus fascia and the rectus muscle of one side, takes a firm bite into the musculature of the bladder at the vault, and comes out through the rectus muscle and rectus fascia of the opposite side, at the corresponding level. This suture is tied later and anchors the bladder securely to the anterior abdominal wall, thus preventing herniation of the peritoneal fold into the wound. Next is the insertion of the so-called Pezzer catheter No. F 36 or whatever size is thought advisable. If necessary the bladder is sutured firmly about the tube which is drawn snugly against the vault of the bladder so that the "mushroom" fits firmly against the bladder wall.

Before closure proper drainage of this tube is seen to. Closure of the wound is by catgut suture for muscle and fascia. Before the skin sutures are placed the "anchoring suture" above mentioned is securely tied. A prevesical drain of iodoform gauze or cigarette drain is placed in the space of Retzius. Skin closure is with silkworm by mattress suture. The wound is dressed.

Postoperative care following cystotomy. Dressing of the wound with alcohol dressings; through the suprapubic tube the bladder is irrigated daily with mild antiseptic solution, as boric, or if there is much pus and mucous 1:10000 silver nitrate solution is used. If the urine has been alkaline, encrustation of the drainage tube may take place. This is obviated by the daily bladder irrigations and by rendering the urine acid by the administration of acid sodium phosphate solution and urotropin. In case there is encrustation of the tube with urinary salts, which might occur in 4 to 6 days, and the drainage is not sufficiently free, the tube is removed, cleaned, sterilized and reinserted, or an *I* tube is put in instead. Either is easily inserted as a firm sinus has by this time formed. Sometimes the tube is not reinserted, should the patient be in proper condition for prostatectomy in a day or two. Usually the tube need not be removed; it may remain comfortably *in situ* for months if necessary, with proper care.

We have abandoned the continuous irrigation and the syphon drainage. The Pezzer catheter drains into an urinal or a wide-necked 8 ounce bottle. This drainage is more simple, more efficient, and certainly more comfortable for the patient. It allows him freedom of movement in bed without the likelihood of disarranging apparatus or of breaking the syphon suction.

Our statistics show that with the use of the indwelling catheter the most frequent and annoying complication with which we have had to deal is epididymitis. The pathology of this condition will be readily remembered when one considers that nearly always the vesical neck and prostatic urethra are the seat of infection and that it requires but a slight exciting factor, such as the moderate traumatism from catheterization, squeezing scrotum and contents between the thighs, low hanging scrotum, etc., to cause the epididymis to flare up with an acute pyogenic infection, either through direct extension or lymphatic absorption. We, therefore, have applied to all cases a method of suspension of the scrotum by means of a T-binder and pads in the perineum to build up a nest in which the scrotum and contents lie suspended. Since using this technique epididymitis has been very rare.

WHEN SHOULD THE PROSTATE BE REMOVED?

This important question naturally comes to mind, and here, we think, is the kernel of the whole problem of prostatectomy. It is not so easily answered as asked. A number of conditions must be considered: the urine, the renal function, the blood nitrogen retention, and not least the general clinical and physical condition of the patient. Each taken separately cannot form a criterion upon which to base a judgment; all must be considered.

In our series, after instituting suprapubic drainage for a period of 10 days or 2 weeks, the specific gravity of the urine rose from a low point to normal or nearly normal, the dry tongue became moist, the sallow skin cleared, the mentality became more acute, the appetite improved; in fact there was marked advance in the general condition of the patient.

There need never be any hurry to perform the second stage—the prostatectomy; indeed, the suprapubic drainage may be kept up for months if need be, or until such time as the patient is in condition for the prostatectomy. Herein lies the value, the safety of this method, for the general surgeon, for the general practitioner, for the man who has not at hand all the facilities of the large modern hospital, who has not at his call trained help, who has not specialized training required for other methods of prostatectomy.

THE PROSTATECTOMY

The second stage, the enucleation of the prostate, is performed under gas anæsthesia; rarely is ether anæsthesia used. However, ether anæsthesia is not contra-indicated, provided it be light, just sufficient to cause relaxation, and short, and the general condition of the patient warrants its use.

With two fingers of one hand in the rectum, so as to bring the prostate upward into the bladder, it is enucleated by the gloved finger of the other hand through the suprapubic sinus. The finger is pushed firmly and gently into the prostatic urethra, which is thereby ruptured on the roof; then thorough enucleation is done along the natural line of cleavage, until the entire prostate, except the posterior lobe, which alone remains, is freed and pushed into the bladder through the opening in the prostatic capsule. There are some who militate against the use of the finger in the rectum; they claim that this forms a fixed point against which one works, and that thus there is danger of rupturing into the rectum; this danger, we think, is slight, whereas the aid that comes from the finger in the rectum is real.

Thoroughness of enucleation is sought rather than any record for rapidity of enucleation. The hyperplastic prostate generally is quite large and easily enucleated, while the fibrous type takes more time and care, being small, hard, and adherent. This latter often requires the use of the prostatic rougeur and in this case the rectal finger again acts as a distinct aid and guard.

After enucleation the prostate is free in the bladder and is removed through the sinus by means of a sponge forceps. The prostatic cavity is thoroughly examined with the finger for completeness of enucleation. Nothing further is done to it.

A moderate amount of bleeding always follows prostatectomy; this comes from the prostatic plexus of veins. It is well to consider, at this juncture, the question of postoperative hæmorrhage. This complication, following prostatectomy, we consider is caused by two things, either by an inherent tendency in the patient to bleed or by the fact that the operator has gone outside the prostatic capsule and natural line of cleavage and has ruptured an artery. The bladder of course should be kept empty, and not allowed to fill with blood-clot. In our series, post-operative bleeding sufficient for packing or any other method of hæmostasis has occurred but twice, and always in the one-stage cases. Bleeding in nearly all cases has been so slight that this has led us to adopt what we consider a considerable advance in the simplification of the management of these cases. We have abandoned catheters, tubes, packing and all method of drainage, except the suprapubic sinus itself following prostatectomy. Whatever clots form at the time of operation are removed with the sponge forceps. The wound is dressed; no tube is placed, no packing inserted. The wound is not sutured.

In the ward, whenever clots form, the nurse in charge of the case lifts away the dressings and gently picks them out. As long as clots form, they are removed and care is taken that the bladder is never full of them, as this would cause the bladder to become distended; it would contract to empty itself and thus cause more bleeding. If the bleeding is too severe and free, a Freyer tube is inserted, and, through this, clots are removed as they form.

Two factors, we believe, have influenced post-operative bleeding in our series of prostatectomy. One is the natural subsidence of the congestion and acute inflammation of the prostate and vesical neck consequent on the institution of suprapubic drainage, and the other is the hæmostatic action of normal horse serum. We have in all of our cases administered subcutaneously, 10 cubic centimeters of horse serum the afternoon previous to prostatectomy. This seems to have had a definite influence in lessening hæmorrhage. In addition, before and after the operation, we administer by mouth, calcium lactate, 20 grains, every 2 hours; this latter acts as a hæmostatic only during the period of actual administration.

Postoperative care after prostatectomy. On arrival in the ward a nurse is detailed to the patient. It is her duty to dress the wound whenever necessary and to remove with sterile sponge forceps the clots that form. The forceps is gently inserted into the sinus and the clots are picked out. Usually, in 12 hours the bleeding has become so slight as merely to stain the dressings, and no further clots come away. The dressings are changed whenever necessary, at least every hour, and they are so arranged that only the dressings immediately in contact with the wound are changed, or only so many as need be. The bladder is left untouched for a period of 3 or 4 days, at the end of which time the first bladder irrigation is performed by means of a catheter through the suprapubic sinus—mild boric or mild silver nitrate solution being used. Following this there are daily bladder irrigations and after 7 to 10 days irrigation may be done by catheter *per urethram.*

Care of the wound is an important business. There is nothing except prostatic obstruction, due to slough, granulation tissue, or the prostatic capsule forming an obstructing ledge, which will more readily delay healing than a dirty wound. The wound is kept clean, first of all by keeping the urine acid; an alkaline urine will speedily form dirty, filthy encrustations and slough on a wound otherwise perfectly healthy. We administer acid sodium phosphate, and see that the patient drinks freely of water and other liquids. Should the wound become encrusted with salts or should the edges become sluggish, silvol crystals applied directly will clean the wound and give a healthy granulating base more quickly and with less discomfort than anything else. The surrounding skin is kept clean and free of urinary salt deposit by means of ointment-vaseline or boracic acid and by frequent dressing. Exuberant granulations are curetted or cut away. The surgeon must remember that the suprapubic wound to be permanently healed must heal from the bottom outward and his efforts should be so directed.

After the sinus has become smaller, healing may be hastened by the use of Biers cupping for 10 minutes twice daily. The suprapubic wound will heal, if it is healthy, if it is kept clean, and if there is no obstruction at the vesical neck or in the prostatic urethra. It may be necessary at the end of 2 or 3 weeks to verify the patency of the

urethra or vesical neck by the passage of the urethral catheter or urethral sounds, if the first two conditions obtain.

Should the suprapubic sinus persist it can be readily closed under local anæsthesia by purse-string suture about it after excision of all scar tissue; and then by folding over succeeding layers of healthy tissue to reinforce the primary line of suture. An indwelling catheter can be placed to insure proper healing, but is not always necessary.

In reviewing our statistics on prostatism a number of interesting facts come to light. During the past 5 years, we have performed the following:

Type of Operation	No. of Cases Operated	Deaths	Mortality Percentage
Perineal	5	0	. . .
One-stage suprapubic	57	2	3.5
Two-stage suprapubic	158	3	2.
Suprapubic drainage only	6	3	50.

Of the deaths in the one-stage cases, one occurred in an osteomyelitis of the tibia from embolus, 22 days after operation; the other from pneumonia, 14 days after operation. All deaths have been from causes outside the genito-urinary system. Pneumonia in the more aged patients, acute cardiac dilatation and cerebral thrombi. No deaths were due to uræmia, formerly the cause of the extremely high mortality rate in the early days of prostatectomy.

The high mortality rate in those cases where suprapubic drainage alone was instituted was due to the fact that all these cases were admitted to the department *in extremis*.

Number of days in the hospital:

1. Perineal prostatectomy:
   Average 81 days
   Shortest 05 days } All complicated cases with prognosis bad
   Longest 92 days }
2. One-stage suprapubic prostatectomy:
   Average 45 days
   Longest 95 days
   Shortest 30 days
3. Two-stage suprapubic prostatectomy:
   Average 50 days
   Shortest 24 days
   Longest 115 days

Number of days' drainage between first and second stage in the two-stage cases:

Average 17 days
Shortest 3 days
Longest 65 days

Average number of days of drainage before prostatectomy:

Perineal 10 days
One-stage suprapubic 11 days
Two-stage suprapubic 22 days

Average number of days before patient is dry and remains so after prostatectomy:

Perineal 50 days
One-stage suprapubic 26 days
Two-stage suprapubic 22 days

CONCLUSIONS

That for the general practitioner and general surgeon the two-stage suprapubic prostatectomy is the safest and simplest method of performing prostatectomy.

That adequate, even prolonged, catheter or suprapubic drainage before prostatectomy is essential.

That the clinical and physical condition of the patient and the laboratory findings together must form the basis for a judgment as to time for removal of the prostate.

That postoperative hæmorrhage following suprapubic prostatectomy by the two-stage method is rare.

That tube drainage following prostatectomy is unnecessary.

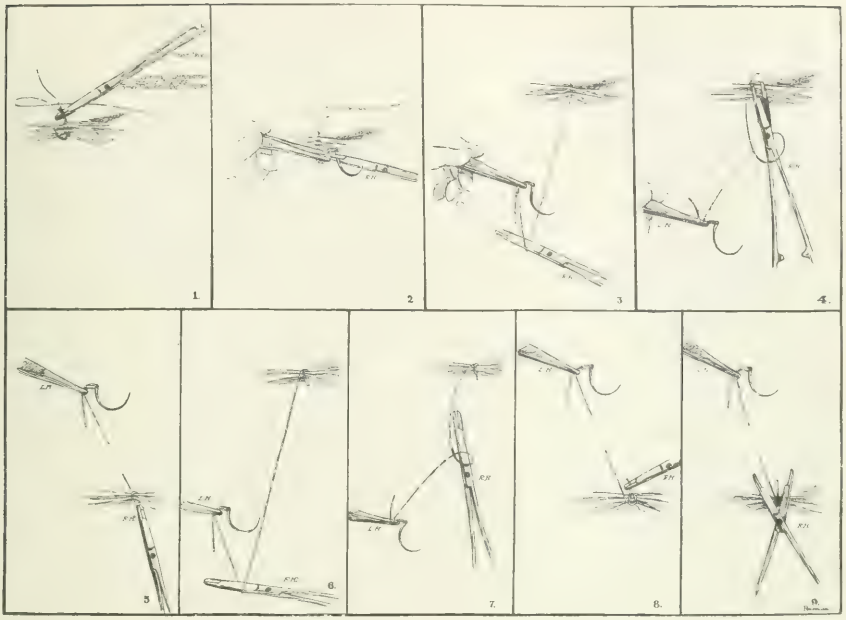
That the simpler the technique and management of prostatectomy is made, the safer it becomes for patient and surgeon.

NO-HAND-TOUCH TECHNIQUE

By A. R. GRANT, M.D., F.A.C.S., Utica, New York

A REHEARSAL of the details necessary to perfect a no-hand-touch technique resolves itself into the possibility of tying knots and ligatures without touching gloves to needle or thread. The accompanying illustrations are self-explanatory and define a method that makes it easy for surgeons, even with limited assistance, to operate upon a joint or a bone without hand contact. While it is easy to make encircling ligatures around clamped vessels, as described in Surgery, Gynecology and Obstetrics, May, 1918, it is my opinion that transfixion ligatures are better.

In our service in France, transfixion ligatures were undoubtedly the reason for almost no postoperative hæmorrhages and would become adopted as standard technique had hostilities continued.



TECHNIQUE

The instrument nurse threads the needle with sterile forceps not touching the gut nor the needle with her gloves.

The surgeon transfixes the tissue, pulls the needle through with needle holder and catches both strands of the suture near the needle with dissecting forceps in the left hand; he pulls on the left end with the left hand forceps until the right short end is only one-half inch from the point of transfixion. The long end should be proximal and the short end distal to the operator.

He lays the point of the needle holder across and on top of the suture just below the tips of the dissecting forceps and makes a loop around the needle holder.

He catches the short end of the suture with the needle holder, keeping its tips close to the site of the knot, while the left hand pulls the first half of the knot tight. He places the tips of the needle holder beneath suture and makes a second loop which completes the reef or square knot.

Note that the needle holder has been placed above the suture in Figure 3 and beneath the suture in Figure 6, a procedure that insures a square knot.

Any needle holder of the Mayo type is best adapted for this method of tying. I have had an instrument made that is a combination needle-holder-tying-forceps-scissors; it is useful to surgeons working alone or with limited or untrained assistants. This instrument is not original with me, for Marion Syms used a similar type 30 years ago and Trendelenburg used a larger affair. Dr. George W. Roberts, of New York, improved the model and curved its tips. The instrument here illustrated has special jaws capable of holding needles and also firmly grasping the finest gut.

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PITUITRIN IN THE THIRD STAGE OF LABOR[1]

By SAUL SEIDES, M.D., New York
Associate Obstetrician, Jewish Maternity Hospital; Assistant Gynecologist and Obstetrician, Israel-Zion Hospital of Brooklyn; Assistant Gynecologist, Out Patient Department, Beth Israel Hospital

THE third stage of labor, though short in duration, carries with it great responsibility for the conscientious obstetrician. He realizes that in this brief period accidents sometimes occur that prove fatal or that lay the foundation for a prolonged and troublesome convalescence. All textbooks on obstetrics emphasize the importance of the careful and skillful management of this stage of labor.

In managing the third stage, the obstetrician strives to reduce the loss of blood to a minimum and to make sure that the uterus is completely emptied and properly contracted and retracted. Several methods are recommended to accomplish these objects. At one extreme is Ahlfeld's policy of strict non-interference, the expulsion of the placenta being left entirely to nature. At the other extreme is Credé's method of forcible expression of the placenta during the first afterpain. American textbooks advocate a middle course, advising watchful waiting, combined with gentle manipulation for 20 or 30 minutes, to be followed by Credé's manual expression. An excerpt from Edgar's *Obstetrics* may serve as an example of textbook teaching in regard to the conduct in the third stage of labor. "The physician or nurse continues by gentle pressure on the fundus to keep up and encourage firm, tonic uterine contractions in order to prevent hæmorrhage and the formation of an intrauterine clot. . . . It may be necessary to use gentle friction by circular motion with the hand, ... or it may even be necessary to grasp the fundus vigorously and subject it to active manipulation to get a prompt response. . . . Usually placental separation takes at least one-half hour. . . . For this period the uterus should be kept under manual observation. If the placenta is not expelled from the uterus at the end of this time, Credé may be resorted to. . . . After the delivery of the placenta the physician or nurse continues to hold the fundus in the hand for an hour." However, even though the obstetrician conscientiously desires to carry out the detailed instructions of the textbook, he frequently finds it next to impossible, especially in cases occurring outside of the hospital and under more or less unfavorable circumstances, such as poor surroundings and inadequate help. At times, the physician must cope with the situation single-handed. Even in the well-regulated hospitals, the obstetrician may be so pressed for time that he disregards the policy of watchful waiting. As a consequence, gentle massage gives place to rough handling, and Credé is resorted to prematurely and sometimes improperly. The result is excessive and unnecessary loss of blood, a traumatized uterus, and troublesome convalescence.

To ascertain whether the third stage of labor can be conducted, under all circumstances, in a simpler and safer manner, I experimented with pituitrin.

The nature of the physiological action of this drug recommends it for use in the third stage of labor. The action of pituitrin on the uterus consists (1) in increasing the frequency of uterine contractions, (2) in augmenting the strength of the individual contractions, and (3) in heightening the tonicity of the uterus.

If a dose of pituitrin is given immediately after the expulsion of the fœtus, the uterus begins to contract about 3 minutes later, the contractions come on at intervals of 2 to 3 minutes, the individual contractions are strong and well sustained, the placenta is expelled in a short time, and the uterus remains firmly contracted and retracted.

For more than 2 years I have been using pituitrin as a routine at the beginning of the third stage of labor in all my obstetrical cases and have found the results to be most gratifying.

In March, 1921, with the approval of the Medical Board of the Jewish Maternity Hospital, the routine use of pituitrin at the beginning of the third stage of labor was introduced in the public wards of the hospital, and the effect of pituitrin on the third stage was carefully observed and recorded.[2]

The following is a report of the procedure adopted and of the results observed in the first five hundred consecutive cases:

As soon as the fœtal head emerged from the vulva, the patient received 0.5 cubic centimeter of pituitrin (B. W.) by hypodermic injection, and observations were made as to the frequency

[illegible] third stage of labor. In his article "Pituitary Extract in Obstetrics" [illegible] of the placenta should be attempted without a trial of pituitary extract."

[1] Read before the New Utrecht Medical Society, April 17, 1922.

of uterine contractions; the number of contractions required to expel the placenta from the uterus; the time elapsing from the moment pituitrin was given until the placenta escaped from the uterus; and the amount of bleeding before and during the expulsion of the placenta. After each contraction the medical attendant sought for the well-known signs indicating that the placenta had left the uterus and had descended into the vagina, namely: (a) the uterus rising up in the abdomen and becoming flattened pear-shaped with a rather sharp ridge at the fundus, (b) the appearance of a soft boggy mass just above the symphysis and below the firm body of the uterus, and (c) the cord at the vulva remaining stationary when the fundus is gently pushed back. As soon as these phenomena were definitely and unmistakably recognized, the attendant placed his outstretched hand on the abdomen just above the fundus, spanning the recti muscles, and the patient was instructed to bear down. This, without squeezing or pressing the uterus, brought about the expulsion of the placenta from the vagina, and terminated the third stage of labor. The patient was then made comfortable and left on the delivery table for an hour, during which time the condition of the uterus and the amount of bleeding were watched and recorded. At the end of this period the patient was taken to the ward. During the 10 days' stay in the hospital observations were made regarding the amount of bleeding during the first 24 hours, the absence or presence of after-pains and their character, the character of uterine involution, and the amount and character of lochia.

Of the 500 consecutive cases observed there were primiparæ, 156; multiparæ, 344; spontaneous births, 450; breech cases, 11; transverse, 1; face, 5; brow, 1; twins, 8; hydramnios, 2; prolapsed cord, 3; versions, 7; forceps, 33; anæsthesia, 42.

Normally, after the expulsion of the fœtus, the unaided uterus remains quiescent from 5 to 20 minutes before it begins to contract again. The contractions occur at intervals of 4 or 5 minutes. On the average it takes about 25 minutes for the placenta to be completely separated. In the 500 consecutive cases in which we used pituitrin in the beginning of the third stage, the average period of rest of the uterus was 3 minutes. The contractions came on at intervals of 2 to 3 minutes. The average number of uterine contractions preceding the signs of placental expulsion from the uterus was two. The average duration of the third stage was 7 minutes. In only one case was the placenta retained due to a spasmodic contraction of the internal os. After waiting 3½ hours, anæsthesia was administered and the placenta dropped into the vagina. In this case the retention of the placenta was probably due to premature and perhaps improper manipulation of the uterus. Manual removal of the placenta was done three times, after the lapse of 4 hours, 6 hours, and 1 hour respectively, the last case giving a history of manual removal of the placenta in the previous pregnancy. In all three cases the cervix was found to be open, and the hand could easily pass up into the uterus. In two of the cases the placenta was found unseparated, but was easily peeled off from the uterine wall, and delivered complete. In the third case there was an unseparated placenta succenturiata in the right cornu of the uterus.

Immediately after the expulsion of the placenta the uterus contracted firmly and stood out prominently. In the overwhelming majority of the cases, while the patient remained under observation for an hour on the delivery table, this state of firm contraction was uniformly and continuously maintained. In only fifteen cases the contraction of the uterus was not well maintained. In these instances the patients received ergot in addition.

After the delivery of the placenta the bleeding was in most instances so slight that the vulva pad applied immediately after the completion of the third stage of labor, was at the end of an hour only slightly tinged. In ten cases the bleeding necessitated the administration of a second dose of pituitrin or ergotol. Among these cases there were conditions predisposing to excessive loss of blood, such as long tedious labor, hydramnios, twins, prolonged anæsthesia, etc. However not one of these cases suffered a blood loss that could be termed a postpartum hæmorrhage.

The comparatively few changes of vulva pads required during the first 24 hours demonstrated that flow of blood had been greatly diminished.

The lochial flow was diminished in quantity, becoming scant about the fifth day, and the change from red to white took place much sooner. At the time of discharge of the patient from the hospital, the lochia was white and scant in 389 cases, serosanguineous in 97, and red in 14 cases.

During the first period after delivery, ranging from 6 to 12 hours, after-pains occurred more frequently than is usual. They occurred even among primiparæ. Subsequently the after-pains were infrequent and mild. Of the 500 cases, 109 had slight after-pain, 28 had moderate, and 18 had severe enough pains to require some thera-

peutic means of relief, 345 did not complain of after-pains at all.

The involution of the uterus progressed with such satisfactory rapidity that a great number of these patients were allowed to get out of bed as early as the fifth day postpartum. The examination on the tenth day postpartum—the day of discharge from the hospital—showed that in 473 cases the uterus was well down in the pelvis, and in only 27 was the fundus above the symphysis.

The morbidity was very low. Only 11 cases had a temperature of 100° F or above for more than one day. These included infected perineorrhaphy cases, 6; acute bronchitis, 1; cystitis, 1; localized phlebitis of the leg, 2; acute salpingitis, 1.

SUMMARY

Five hundred consecutive cases received each 0.5 cubic centimeters of pituitrin at the beginning of the third stage of labor. The uterus was untouched save when the medical attendant sought for the signs indicating that the placenta had left the uterus. The placenta was expelled from the vagina by the voluntary effort of the patient assisted by the medical attendant who would span and support the recti muscles. There was one case of simple retention of the placenta, and three cases of unseparated placenta that required manual removal. The contraction of the uterus was uniformly and perfectly maintained. The loss of blood was surprisingly small. Involution of the uterus progressed more rapidly than usual. The after-pains were, on the whole, less frequent and milder. The general health and well-being of the patients were exceptionally good.

From the above results it is evident that pituitrin, administered at the beginning of the third stage, offers the following advantages:

1. It considerably shortens the third stage of labor.

2. It acts as the most effective preventive of postpartum hæmorrhage, and especially in cases of protracted labor, overdistention of the uterus (hydramnios, twins), intra-uterine manipulation, and where narcotics or anæsthetics are employed.

3. It reduces to a minimum the loss of blood incident to the third stage and to the period immediately following it.

4. It tends to lessen the amount of lochial discharge and shorten its duration.

5. It renders unnecessary all uterine manipulation (gentle massage, kneading, and compression) employed for the purpose of encouraging uterine contractions and guarding against relaxation.

6. It makes Credé's manual expression of the placenta entirely unnecessary.

7. It aids the involution of the uterus.

8. It tends to diminish the after-pains which are due to the accumulation of blood clots in the uterus.

9. Lastly, it diminishes the frequency of retained placenta.

Physicians generally refrain from using pituitrin before the placenta is cut as they fear that pituitrin may cause its retention. They evidently associate the action of pituitrin with that of ergot. But there is this difference between the action of the two drugs: While ergot produces a lasting tetanic contraction of the uterus, pituitrin simply intensifies the normal uterine contractions, which are intermittent. Furthermore, the factors primarily responsible for the retention of the placenta are: (a) spasmodic contraction of the internal os, (b) paralysis or atony of the fundus of the uterus, and (c) disturbance of the retroplacental hæmatoma. One or all of these factors may be created by excessive or improper manipulation of the uterus, especially when an attempt is made to express a placenta that is as yet unseparated. The use of pituitrin renders manipulation of the uterus unnecessary, hence eliminates the principal cause of the retention of the placenta.

The results obtained in the above 500 consecutive cases demonstrate conclusively that pituitrin administered at the beginning of the third stage of labor not only is perfectly safe, but also that it is of distinct benefit to the patient and of considerable advantage to the attending physician, rendering his management of the third stage simpler and safer.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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JANUARY, 1923

CRANIAL AND INTRACRANIAL TRAUMA

FRACTURE of the skull and the concomitant injury of the brain were favorite subjects of discussion long before the era of modern surgery, and yet there are certain aspects about which differences of opinion and differences of practice persist. The mortality, high as it now is, has been reduced by the elimination, to a large extent, of meningitis as a complication. The immediate and proper management of the scalp wound in compound fracture of the vault and the hygiene of the nasopharynx and the external auditory meatus in basal fractures has reduced measurably the incidence of meningitis. Urotropin is always prescribed with childlike faith but, if it be true that the drug is effective only in an acid medium, it must be inert in the cerebrospinal fluid.

Putting aside the question of infection, there remain two factors which are responsible for the majority of fatal cases; hæmorrhage from the middle meningeal artery and cerebral contusion. The clinical picture of hæmorrhage of the middle meningeal artery has so many distinctive features that one might forecast its recognition and appropriate treatment with but few exceptions. And yet in an analysis by LeCount and Apfelbach[1] of a series of cases in the Cook County Hospital, hæmorrhage from the middle meningeal artery was unrecognized and a cause of death in a not inconsiderable number of instances. These statistics are quoted as a warning to correct the prevailing impression that the symptoms of middle meningeal hæmorrhage always conform to the classical description and are therefore easy of interpretation.

Cerebral contusion and laceration, with or without basal fracture, present the most difficult problem from the standpoint of treatment, and they are the most frequent cause of the fatalities of intracranial trauma. The outstanding feature in the pathology of contusion and laceration is the cerebral œdema, more or less widely diffused according to the violence of the injury, and the concomitant increase in intracranial pressure. Because of the latter, and since the introduction of the operation, subtemporal decompression, resort to this operation, more or less indiscriminately, has become an all too prevailing practice. This statement invites the question, how shall one discriminate?

Let us assume without argument that there is no justification for the immediate resort to decompression, that is, immediately or shortly after the injury. A cerebral trauma, so grave that without intervention death follows within the first 6, 12, 18, or even 24 hours, will not be influenced by a subtemporal decompression. In these cases there may be a grave cerebral anæmia due to the rapid in-

[1] J. Am. M. Ass., 1920, Feb. 21.

crease in intracranial pressure, but the desperate situation is created by a lesion within the medulla itself. It may be an extension of the rapidly diffusing œdema, or an actual intramedullary contusion or hæmorrhage, gross or microscopic. Whatever the pathology, the lesion is within the brain stem and cannot be influenced by a subtemporal decompression. Hence the futility of the operation under these circumstances. May we not assume, too, without argument, that a subtemporal decompression is without justification in cases of so moderate a degree of trauma that the recovery of the patient is at no time in serious doubt. It has been claimed that subtemporal decompression in these cases assures a more prompt recovery from the immediate effects and reduces the incidence of the late effects of intracranial trauma. This is, however, a mere assumption; there is up to the present time no substantial evidence in support of it.

Having eliminated the very grave and the milder cases, there remains an intermediate class, and it is to this class that the operation in question may be performed with propriety. Even in this intermediate class one should discriminate. Operation is appropriate only in selected cases. How shall this selection be made? The decision must be made usually in the second 24 hours after the injury, not before and seldom later and the decision must be based upon evidence of increasing pressure. Too much stress must not be laid upon single observations. We hear too much about the increase of intracranial pressure, as measured by the lumbar puncture manometer, about increase in blood pressure, about papillœdema, as indications for operative intervention. The blood pressure and papillœdema are not infallible signs. The evidence should include a complete survey of the cerebral functions disturbed; stupor or unconsciousness, muscular relaxation, reflex disturbance, Cheyne-Stokes phenomena, and as supplementary evidence only the blood pressure papillœdema, etc. As the cerebral anæmia becomes more intense, the disturbance of cerebral function becomes more pronounced and one soon learns to evaluate the degree of cerebral anæmia in terms of disturbed function. Admittedly, the selection of the time for operation requires an intelligent grasp of the pathology, the physiology, and the clinical evidence of brain trauma, plus the exercise of judgment on the part of the surgeon. But after all, are not these the requisites for success in all fields of surgery? Rules of thumb are poor props on which to build a reputation.

Even in properly selected cases, subtemporal decompression will not tide the patient over the crisis always. As a matter of fact, subtemporal decompression is most effective in those cases in which there is an excess of cerebrospinal fluid in the subarachnoid and subdural space; and the opening of the dura releases the tension by allowing the escape of fluid. *Per contra*, the operation is least effective when there is no free fluid and the herniated brain engages snugly in the dural opening.

CHARLES H. FRAZIER.

GASTRO-INTESTINAL OBSTRUCTIONS

THE experienced surgeon realizes only too well the influence on surgical mortality of operations performed in the presence of obstruction in the gastro-intestinal tract. That radical operations in cases of acute obstruction are seldom permissible has been demonstrated over and over again, and it is generally accepted that some form of drainage operation to relieve this dangerous feature should be performed before the radical operation is undertaken. In these preliminary

operations, it is essential that general anæsthesia of any kind be avoided. Many surgeons have had the unfortunate experience of having patients under a general anæsthetic drown, through the filling of the bronchial tubes with regurgitated intestinal secretions, or die subsequently from pulmonary infections resulting from inhalation of such material. Some form of local anæsthesia, spinal, regional, or infiltrational, is necessary. In the subacute and chronic cases of obstruction the surgeon is confronted with a serious problem which taxes his judgment to the utmost. When there is doubt as to the method of procedure, the operation should be divided into stages, or the two-stage operation should be used if an obstructing intestinal tumor requires removal. In the extremely acute cases it is wise to perform an enterostomy without attempting exploration.

The obstructed stomach, unlike the obstructed intestine, can be emptied with a stomach tube, although it may take several days to remove the quantity of fermenting and putrefying material which sometimes accumulates. While the stomach is being tubed and given a chance to regain its tone, the body fluids can be restored by 6 per cent solutions of glucose, administered by proctoclysis, or 2 and 3 per cent solutions subcutaneously. Following gastro-enterostomy in such cases, gastrojejunal healing may be greatly delayed. Occasionally when reopening of the wound has become necessary a few days after operation for such conditions, the jejunum has been found to separate from the stomach at the site of the gastro-enterostomy like wet paper. It is important in performing a gastro-enterostomy in these cases to make a large opening in the mesocolon and attach its margins firmly to the stomach. In most cases in which there is poor drainage, or in which angulation takes place at the site of a posterior gastro-enterostomy, causing vomiting of bile, the so-called vicious circle, it will be found that the margins of the opening in the transverse mesocolon have become loosened from their attachment to the posterior wall of the stomach and slipped down over the gastro-enterostomy, thus angulating the jejunum.

In cases of colonic obstruction, the distention ulcer of Kocher, usually of the cæcum and ascending colon, is occasionally encountered. The patient may apparently be doing well as the result of a colostomy, when there is sudden perforation of an unsuspected ulcer or ulcers at the head of the colon and the abdominal cavity is flooded with the intestinal contents, with consequent death within a few hours.

In cases of obstruction of the pelvic colon and rectosigmoid, a preliminary colostomy far to the left is advisable, as this makes it possible to open the abdomen in the middle line for a secondary procedure which may be carried out without danger of contamination. The colostomy is of great value not only in relieving the obstruction, but in permitting thorough cleansing of the involved fragment of the colon before the radical operation is undertaken.

In cases of obstruction of the splenic flexure and descending colon a colostomy in the transverse colon gives excellent results. In certain cases the colostomy should be made close to the sigmoid growth, so that after the obstruction is relieved the colostomy and growth may be removed simultaneously through a single incision at the second radical operation. When the radical operation is performed in cases of this type it is sometimes wise to make at the same time a protective cæcostomy after the appendix-stump method advocated by Willy Meyer. WILLIAM J. MAYO.

MASTER SURGEONS OF AMERICA

HUNTER HOLMES McGUIRE

"The greatest thing any living soul can do is to see something clearly and tell it plainly."

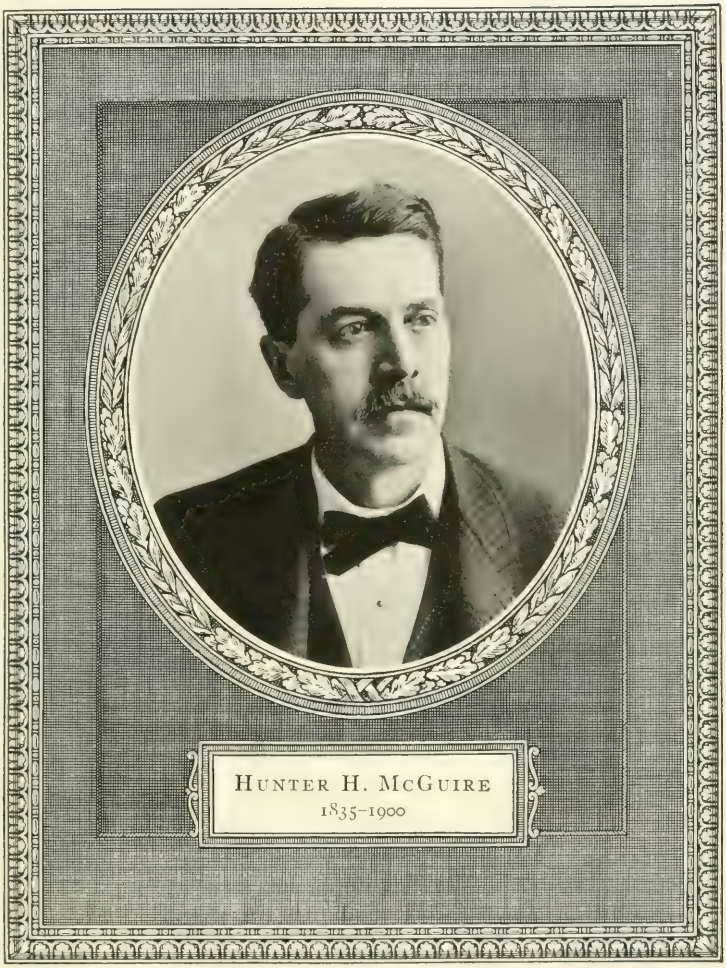
HUNTER HOLMES McGUIRE was born at Winchester, Virginia, October 11, 1835. He was the son of Dr. Hugh Holmes McGuire and Eliza Moss of Fairfax County, Virginia. The family were originally from the County of Fermanagh, in Ireland. His grandfather, Captain Edward McGuire, was a well-known figure in the Continental Army.

Young Hunter received his academic education at the Winchester Academy, where his father before him had been a student. His early medical training was gotten at the Winchester Medical College, a school founded and conducted by his father and a group of physicians. His studies were later completed in the medical schools of Philadelphia.

From 1856 to 1858 he held the Chair of Anatomy in the Winchester Medical College. He then returned to Philadelphia, where he conducted a quiz class with Doctors Pancoast and Luckett. It was about this time that the shadow of John Brown dropped like a black curtain along Mason and Dixon's line, and men on either side no longer saw clearly nor understood one another. It was like "the burden of Egypt"; when the Egyptian was set against the Egyptian, and they fought, every man against his brother, city against city, and kingdom against kingdom. Feeling ran high in the City of Brotherly Love; and, as it has always been and doubtless always will be, the sparks fell first and blazed quickest among the students of the city.

It was now that young McGuire first showed those qualities of leadership that were to carry him to greater and greater heights in later years. A young man comparatively unknown, without special power of oratory or persuasive eloquence, he quickly organized the Southern students, three hundred strong, and led them in a body to Richmond, to finish their studies in the more kindly and sympathetic atmosphere of the Medical College of Virginia. Having located his friends in congenial surroundings he soon went to New Orleans and took up the practice of his profession.

And now came war! It was 1861, and we find young McGuire a private in the ranks of the first volunteer company that marched out of Winchester. He



HUNTER H. MCGUIRE
1835–1900

was soon singled out by Jackson, who was quick to see those qualities that make for executive success, and so in a few months we see him medical director of Jackson's Army, a position which he held until the enactment of that staggering tragedy at Chancellorsville. After the death of his chief, he served as medical director of the Second Army Corps until the close of the war.

To see how well he bore himself in the eyes of that rigid disciplinarian, one need only glance at Jackson's official reports and dispatches, which are filled with a generous measure of praise for his medical director. It was he who inaugurated the freeing of captured Medical Officers, a generous and humane inspiration which was quickly reciprocated by the Federal Army, thus establishing a splendid precedent which soon became a recognized practice. Much has been written and more might be told of his military record, of his intimate association with that master of strategy in his brilliant campaigns in the Valley of Virginia, of the lightning-like strokes that fell, no man might say when or where. But in the fulness of a life so big, so replete with varied activities, the chronicler must not be tempted to linger too long in one field.

In 1866 he was married to Miss Mary Stuart, daughter of Alexander H. H. Stuart, of Staunton, Virginia. To them were born three sons and six daughters.

He now made Richmond his home and once more entered on the practice of his profession.

In the midst of a busy life he always found time to pause or stop to battle for the right. Notable among such occasions was the fight that was being waged by Captain John Cussons and others against the histories that were being used in the Southern schools. To keep the facts of history straight, when vision twisted and warped by bitterness would have given our children a false impression of what their fathers fought and died for, was a cause he could not resist. Into it he threw himself with all his whole-hearted vigor and force, until the desired aim was accomplished. This achievement alone would have set him apart as a man among men.

But it is not for this that he is best remembered. It is not for the long list of professional honors that were heaped upon him; from president of the Medical Society of Virginia, of which he had been a founder, to president of the Southern Surgical Association, president of the Association of Medical Officers of the Army and Navy of the Confederate States, president of the American Medical Association, and president of the American Surgical Association. It is not for the honorary degrees of doctor of laws conferred upon him by the University of North Carolina and Jefferson College of Philadelphia. It is not as the founder and president of a great Medical School, the University College of Medicine, which sent hosts of young men to all the States in the Union. It is not as founder of St. Luke's Hospital, one of the earliest private hospitals in the South, in which his work still lives and goes on under the skilful management of his gifted eldest

son, Dr. Stuart McGuire, whom he reared and trained to fill his place when the time should come for him to rest from his labors. It is not for any of these notable achievements that men best remember him or most delight to do him honor.

But it is Hunter McGuire the teacher who has left his image deeply graven on all the hearts and minds of men with whom he came in contact. This is the figure that stands out clear-cut, pre-eminent.

But what were the qualities of this tall, gaunt, angular man, without eloquence of speech or charm of voice or manner, that made men listen to his every word, that make them remember words, phrases, sentences, with every inflection of his voice, for nearly half a century? It was not the clear intellect of the man that made this compelling appeal. It was a deep, encompassing love of his fellow man; never expressed, but shown in a thousand ways, that sets him thus apart.

In those days surgeons were evolved, they were never made. They came up from the practice of Medicine by slow degrees, with toil and labor. But the process made well-rounded men, and Dr. McGuire was no exception, for he was first a brilliant physician, and then a distinguished surgeon. He had a quick intuitive grasp that was at times almost uncanny. He doubtless never reckoned in percentages. He seemed not to work deductively nor through the slower process of elimination.

His mind, a veritable treasure trove filled with the riches of experience, seemed able instantly to flash out a duplicate of any clinical picture that might be needed for comparison; just as the finger-print expert might reach down from his files the fatal duplicate of the criminal's thumb print.

Each case was with him a separate thing to be reckoned with individually. But first of all it was a living human being with the love of life in his heart and an inherent right to live. He seemed the husband pondering the problem of the sick wife; the father looking down on the afflicted child; and, at times, with these little crippled ones, the touch of the big red hands was even that of the mother herself. This was the key, the secret of this man's power to chain men and women to him blindly for a lifetime; a deep, far reaching, practical humanity, that was all the more beautiful for blunt efforts at concealment.

"He saw things clearly and told them plainly."

As has been said, he was not an orator; and yet no man ever got a fuller meaning out of words than he. Abruptly he would say: "And that poor fellow's suffering was frightful." Immediately that word "frightful" took on a new meaning, and one saw the poor fellow suffering the very tortures of the damned.

Who ever heard the history of the first prostatic on whom the first suprapubic cystostomy was done—the operation that sent his name halfway round the world; who ever heard that simple story of the extremity of human suffering and its blessed relief, and ever forgot a single detail of that vivid picture?

Never was he at better advantage than when, as he would sometimes do, he pushed all the operative work aside and had a blanket spread on the amphitheater floor, with a group of little crippled children on it. Hip-joint disease, Pott's disease of the spine, tuberculosis of the joints and bones; how he hammered home the early symptoms and diagnostic signs! How mercilessly he fixed the personal responsibility for failure to recognize them! How many men who read this must instantly visualize that picture!—the little hunch-back, with rigid spine, squatting down to pick up his bunch of keys. Is it not the very acme of teaching that men will so remember?

In his operative work he was practical, dextrous, and ingenious. He was quick to make a decision, and once his decision was made he went through with his plans to the end.

It must be remembered that much of his work, like that of the pioneer, was in untrod fields; much of it was done in pre-aseptic times when the mortality rate alone, even in skilful hands, was enough to stagger any but the most courageous. Unlike many men of his time who faced a new era, he was quick to see the good of the new, to grasp it, and turn it to his uses. He wasted no time in the forlorn fight of the older order in its bitter rear-guard action against the new. Listerism he readily embraced, and we find him an enthusiastic exemplar of its principles. When many men of his age were vigorously assailing the germ theory, he was busily engaged in teaching those very principles and demonstrating them by practical application in the operating room. With rare judgment which seemed almost intuitive he gleaned what was good from the new and winnowed out the chaff. In short, he was among that small group of men who marched on with the times.

It was only a year before his last illness that he had completed and equipped a large new modern hospital to take the place of the old, and to better care for his ever increasing practice.

He was never an idler, but was always engaged in some useful activity, as though time were too precious a thing to squander. His recreations were few. He most loved to be in his summer home, "Westwood," not far from Richmond, in a grove of great oaks, with flowers and birds and growing things about him. It was here, surrounded by his family, that, after a lingering illness of more than a year, on the morning of September 19, 1900, death claimed him.

To his funeral the people flocked to do honor to his memory; men, women, and children, from every walk of life, and old comrades clad in gray. A year later out of the full hearts of a grateful people a monument arose in the Capital Square, close to his beloved Jackson. There he sits, calm, dignified, reserved; just as he sat listening to the tales of suffering of his people—counselling, advising, always helping, giving. Every line of the pose is perfect. The sculptor, indeed, has modelled well. There he sits close by the scenes of his greatest activities:

close to the hospitals and institutions of learning that he founded and fostered; in the shadow of the capitol of the Confederacy; close to Jackson.

What are they thinking of, these two strong men of bronze, as the years go by? What is in their hearts, as the South sends forth its thousands of young men, khaki clad, marching to new music under the flag they fought against? What do they say to one another, far in the night when the lights are low?

Who knows?

W. Lowndes Peple.

CORRESPONDENCE

INTERPOSITION OPERATION FOR UTERINE PROLAPSE

To the Editor: The interposition operation for procidentia uteri is one which I fancy is held in the utmost respect by all gynecologists who have had experience of it. It is a most excellent operation, but it must not be expected to do the impossible. If we look at Figure 5 in Shaw's recent article in SURGERY, GYNECOLOGY AND OBSTETRICS (March, 1922) we can see exactly what it may, and what it certainly may not be expected to do. It may be expected to keep up the bladder permanently, to support the anterior vaginal wall and the body of the uterus, so long as that body is too large to be able to rotate on a transverse diameter in the pelvis in such a manner as to bring the cervix down toward the vulva. But it may not be expected to offer a barrier to the descent of the cervix, once the body has begun to atrophy, or when it is already atrophied. This last point must be obvious to anyone who considers the condition of the uterus, the vagina, and their ligaments prior to operation. The uterosacral ligaments and the lateral ligaments are lengthened until their uterine insertion can be felt at, or a long way outside, the vulva. The vault of the vagina is dragged down to the same position, and its suspending ligaments are either torn or stretched. If, therefore, the repair operation is limited to the shortening of the cervix the interposition of the uterus, and the repair of the perineum, once the uterus lessens in size the floating vaginal vault and cervix, under normal conditions must again descend, and, as Shaw says, the results of the operation will certainly not be brilliant.

It is a good many years now since, in common with many other gynecologists, I pointed out that if a prolapse operation is to succeed it must not merely bring the uterus back into a suitable position but must also, so far as possible, remove every factor which tended to force it or to allow it to travel out of that position. This is only another way of saying that all the associated lesions of the displacement must be set right, so far as possible. If this is not done the neglected lesion will eventually cause so great a strain to be thrown on the repaired structures, that, whereas they might have been quite able to stand a normal strain, they yield under the abnormal one. If this is true then it is obvious that so gross a lesion as the marked lengthening of the uterosacral ligaments must be cured, or else the cervix is still free to descend.

I think that if Shaw will take this point into consideration, and will carry out the routine shortening of these ligaments in all cases in which they require shortening, he will find that the results of interposition will be widely different from those he records. I regard one or other of the following procedures as the most efficient prolapse operations at our disposal at the present time, and I have been carrying them out for a good many years. I am sure there have been some failures, but I have not seen them. In young women in whom it is necessary to make allowance for future pregnancies, I advise curetting, amputation of the cervix where necessary, shortening of the uterosacral ligaments, anterior colporrhaphy, colpoperineorrhaphy, and shortening of the round ligaments (Alexander). In women near or past the menopause, I advise curetting, amputation of the cervix where necessary, shortening of the uterosacral ligaments, interposition, and colpoperineorrhaphy. The technique of the associated operations of cervical amputation, uterosacral shortening, and interposition, is a little difficult when one tries it for the first time, but a very little experience soon shows the best manner in which to adapt the different steps of the operations to one another.

In partial prolapse, where the lengthening of the uterosacral ligaments is but slight, then obviously it is unnecessary to interfere with them, just as it is unnecessary to amputate the cervix when its condition is normal. In complete prolapse on the other hand—at the risk of repetition I must emphasize the point—the performance of interposition alone is an inadvisable and unnecessary method of courting failure.

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TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held June 16, 1922, Dr. William C. Danforth, Presiding

MYOMATOUS UTERUS

William M. Thompson: I am showing you this specimen of a myomatous uterus, not because of its size or anything peculiar in its pathology, but because the uterus was rotated from left to right, the right broad ligament was posterior and the left broad ligament was anterior and in contact with the bladder. The specimen was 10 inches long, 10 inches wide, and 7 inches in anteroposterior diameter. The patient was 49, unmarried, had menstruated very profusely for one week previous to the operation. For 6 months menstruation had been profuse, but regular. Her physician had tried for 5 or 6 months to induce her to go to the hospital. Finally worried by the rapid growth and the pain in the lower left quadrant of the abdomen, she was induced to undergo the operation. The rotation was caused by the growth of the myomatous nodules which acted as a lever on the body of the uterus.

The difficulties encountered in the removal of such a tumor are usually found in the proper dissection of the tumor from the bladder. Present-day authors give small space to the removal of difficult uterine tumors. The technique must be varied in accordance with the growth. It is not always possible to dissect out the fibroid beginning with one side and going down on across and up. Very often the problem taxes the ingenuity of the operator because the growth is so impacted and the tumors are found low in the uterine body, as was the case in this specimen.

DERMOID CYST OF THE OVARY CONTAINING A BUCCAL CAVITY WITH PARTIAL DENTITION

Dr. Aldo K. Germann: Teratomata in the broad sense may be divided into two distinct types: dermoid cysts and solid teratomata. In dermoid cysts the tissues found resemble the adult type and show a tendency to form rudimentary organs. The three embryonal layers are usually represented: ectoderm by skin, hair, sweat and sebaceous glands, teeth, retina, nerve tissue, etc.; endoderm by intestine, bronchi, etc.; mesoderm by cartilage, bone, and muscle. Although in most cases all three layers are found, cysts have been reported which show only one or two of the layers. The most common single layer type is the struma ovarii made up of only thyroid tissue.

Dermoid cysts are more frequently unilocular and are usually of moderate size, although they may rarely reach the size of the patient's head. While they occur more frequently unilaterally, bilateral occurrence is quite common. This latter fact causes the careful surgeon to examine the opposite ovary in every case of dermoid cyst.

Dermoids are usually surrounded by a fibrous wall of varying thickness, while they are usually lined with more or less completely developed cuticular structures: corium, papillæ, epidermis, hair follicles, sebaceous glands, etc. The cyst cavity frequently contains a thick, white, greasy material composed of flattened epithelium, fat, cholesterin crystals, hair, teeth, bone, cartilage, pharyngeal ciliated epithelium, striated muscle, thyroid, nerve fibers and cells. It is generally conceded that the epidermal structures predominate. On the inner wall of the cyst, there is commonly found a projection called the dermoid papilla which has been regarded as the embryonal anlage from which the various structures arise.

Solid teratomata, on the other hand, contain tissues in an early fœtal stage of development, and elaborate organ formation is not seen. Myxomatous connective tissue, sarcoma-like and carcinoma-like stretches are intermingled with innumerable small cysts lined by varying epithelium. Cartilage, bone, undifferentiated striated muscle, neuroglia cells, etc., occur. This type of tumor is more malignant and more frequently metastasizes. The malignancies are usually of a sarcomatous but may be of a carcinomatous nature.

There are numerous theories regarding the origin of teratomatous tumors, the most important of which will be briefly sketched below. It was at one time considered that the presence of a teratomatous, or so-called dermoid, ovarian tumor was positive proof of the unchastity upon the part of the possessor. In other wards, the development of this tumor was impossible in the absence of an impregnated ovum. This theory is obsolete.

MacCallum, in his *Text Book of Pathology* (1919), accepts the theory that teratomata are formed from cells split off from blastomeres. He says: "It is obvious that there is a chance for the development of a mass of tissue of almost any degree of complexity from a blastomere, if we are willing to assume that it may become independent of the others at

some stage in the segmentation. This idea involves the further assumption that this independently growing blastomere may remain attached to the main embryo or become partly or completely surrounded by it in its growth, so as to be finally included in its body. With this explanation there is no difficulty whatsoever in understanding the localization of a teratoma, in the testicle, or in the brain while with the others which involve fertilization and development of ova, etc., insuperable obstacles are met with in many cases. With this explanation, too, there is no difficulty in comprehending the formation of teratomata of all degrees of complexity down to the simplest cysts, composed of one or two types of tissues, whereas, if they arise from fertilized polar bodies, primary sex cells, etc., we should expect in every case growths more closely simulating complete individuals. There is such abundant material illustrating every stage of attachment, inclusion, and final complete enclosure of one body in the other that no assumption is required and the story is practically complete."

Marchand put forth the theory of fertilization and development of the polar bodies, but to quote MacCallum again: "There is practically no evidence in its favor, and it has been pointed out that there may be multiple teratomatous tumors which could not be explained on this basis, since at most there are but two polar bodies."

J. R. Goodall of Montreal has worked extensively on the problem of the origin of teratomata. He says: "There is little doubt today that ovules, by a system of parthenogenesis, are responsible for the presence of dermoids and teratomata. It is very probable that parthenogenesis sets in soon after ovulation. The altered conditions in the ovaries at that time (variations in blood pressure, in intrafollicular pressure, changes in oxygen supply) furnish the necessary stimulus. There is no adequate scientific explanation for the extragenital cases. Those of the trunk and peritoneal cavity, however, may have the same origin as those of the ovary, ectopic ovarian tissue."

Teratomata are not rare. Almost 10 per cent of ovarian tumors at the Mayo Clinic were found to be teratomata. They occur in patients varying from infancy to old age, but are conceded to be the most common ovarian tumor up to the age of puberty. These tumors usually have a long pedicle which is one of the main factors in producing symptoms.

There may be no symptoms associated with the tumors, as in the case which I am reporting. There is usually no characteristic menstrual or sexual history. Harris, however, reported a case associated with precocious sexual and somatic development. The growth of the tumor was associated with the beginning of puberty at the age of 5 years. The body development was that of a child of 9 years. The tumor was found to be a complex cysto-solid teratoma with definite adenocarcinomatous areas. There was no menstruation and no further precocious growth after the removal of the tumor. Thirty months after the operation there was no discoverable recurrence. The symptoms are chiefly those resulting from torsion and compression.

Photograph of specimen showing interior of the cyst removed from patient of Dr. Germann.

When dermoids are associated with pregnancy, there are two chief conditions which must be considered. In the early months of pregnancy the dangers are most frequently from torsion of the pedicle and infection. During the latter months of pregnancy, torsion, gangrene from pressure, rupture, and suppuration may take place. These tumors may also block the pelvis during labor.

In the diagnosis of these tumors, the history and symptoms sometimes give important data. In palpating the cyst bimanually, we may sometimes get some help from the cystic contents, thus: hair would possibly give a characteristic, palpable sensation; the sebaceous material might give a putty feeling, while bone and teeth might be felt as hard objects. These physical findings, however, appear better on paper than in the examining room. Since these tumors have long pedicles, it is said that they have a tendency to float in front of the uterus. Last, but of very great importance, is the X-ray examination. If teeth or bones are present, the X-ray will make the diagnosis.

The treatment is operation by the abdominal route as soon as the diagnosis is made, especially in early co-existing pregnancy. When pregnancy is well advanced and the tumor is not obstructing the outlet, the operation may be delayed. It is the consensus of opinion now that a normal pregnancy should not be interrupted. Francis B. Dyle, of Brooklyn, and Frank Benton Black, of Philadelphia, each report a case of dermoids complicating pregnancy in which the tumors were removed and the patients were delivered of living babies at term. Morphine was used freely after the operation in both of these cases.

In every dermoid cyst the opposite ovary should always be carefully examined, even if it must be partially sectioned to be sure it contains no pathological areas. Some of these ovaries appear normal on the outside, while a gross section will reveal the presence of a dermoid.

Every dermoid cyst should be removed intact and not tapped before removal. Many of them are infected. Dr. O'Shansky, of New Haven, reported a dermoid from which he isolated typhoid bacilli. The patient had had typhoid fever 2 months previous to the operation. Graves says the contents of these cysts are also corrosive and conducive to peritonitis.

The case which I report is unusual and there are several distinctive features which I would like to bring out.

Case No. 14772. G. H., single, age 26, entered the Presbyterian Hospital, August 3, 1921, complaining of vomiting. Her menses began at 13 years, were regular, every 28 days, lasted for 5 days, and were somewhat profuse the first day or two. There was no dysmenorrhœa. Her last menstrual period was June 19, 1921. The patient began to vomit July 24 and became progressively worse until she entered the hospital August 3. She was admitted to the medical service and put on appropriate treatment. The urine, blood, and gastric examinations were normal. The routine pelvic examination by the internist revealed a mass in the left adnexa. The report of the gynecological service was as follows: cervix definitely softened; uterus soft and enlarged, typical of pregnancy; a rather large, firm mass extending to the left of the uterus; right adnexa normal; small fibroid on the anterior uterine wall. Pre-operative diagnosis: pregnancy, possibly ectopic, or intrauterine pregnancy with subserous fibroid. There was some vaginal bleeding after the examination.

On August 14, 1921, the patient was operated by Dr. N. Sproat Heaney. Mid-line incision. The omentum was adherent to the bladder, anterior wall of the uterus, and the left appendage area. The uterus was the size of a 6 to 8 weeks pregnancy. There was a small subserous fibroid 1 inch in diameter on the anterior uterine wall. The right tube was of practically normal size but showed some inflammatory adhesions. The right ovary was of normal size and appearance but bound down to the pelvic wall by adhesions. The left appendages had lost their identity in a hard rock-like swelling, larger than the fist, lying to the left of the uterus, bound down to the pelvic wall, and partially blocking the inlet. The sigmoid was plastered over this mass. The tumor was ruptured during removal, allowing the escape of a foul-smelling pus, which was immediately taken up by laparotomy sponges. The tumor, though extensively adherent, was removed, leaving the left pelvis raw. The sigmoid and rectum were sutured over the raw areas. The small fibroid was enucleated. The incision was closed, leaving a superficial drain in place.

Owing to the bleeding upon vaginal examination (threatened abortion) and the severity of the operation, the uterus was emptied by dilatation and curettage. Typical placental tissue was removed, but the fœtus was not found.

Operation: Left salpingo-oophorectomy; myomectomy; abortion.

Postoperative results: The wound was infected but healed by secondary union and patient was discharged in good condition.

Gross pathological report. The tumor mass, removed, measured 7.5 centimeters by 6 centimeters by 4 centimeters. It was covered with dense fibroid tissue. Along one edge of the tumor and firmly adherent to it was the thickened, enlarged tube containing a rather thick pus. The tumor was sectioned and found to contain a large cyst filled with gelatinous material. In describing the interior of the cyst, Dr. Frederick B. Moorehead says:

"The interior of the specimen illustrates a fairly well formed mouth with partial dentition; on the left side two well developed bicuspids in perfect occlusion, and on the right side a well formed molar and what corresponds to a poorly formed wisdom tooth. On the floor of the cavity are the distinct and well formed outlines of the tongue, showing the median raphé. The vault in a good representation of the palate, and the sides illustrate splendidly the buccal apertures. It is interesting to note the presence of caries in two of the teeth." Numerous areas were taken for microscopic diagnosis. The accompanying figures are sketches of the tumor.

Microscopic diagnosis. The cavity of the cyst was found to be lined with squamous epithelium. No hair follicles or sebaceous glands were found. The cyst showed definite evidence of infection, as the epithelial as well as subepithelial structures were crowded with leucocytes.

Embryonic, as well as mature, connective tissue was found. Muscle strands and fat cells were also present. The case presents several distinctive features:

1. There were no symptoms relative to the tumor and the diagnosis of a dermoid cyst was not made. The tumor was found in routine pelvic examination.

2. The cyst was infected and associated with a pus tube on the same side.

3. The tumor was bound down with firm adhesions, did not have the usual pedicle, and blocked the pelvic inlet.

4. The question arises as to whether or not the uterus should have been emptied. The vaginal bleeding on examination, together with the severity of the operation, would probably have resulted in an abortion with the possibility of a second operation. The fact that no ovum was found after a careful examination would suggest that it was either overlooked or, which is quite possible, that the ovum had been absorbed. No microscopic changes, however, were seen in the chorionic villi.

5. An X-ray examination would have made the diagnosis, had the condition been suspected.

6. As seen in the microscopic and macroscopic report, the cystic cavity took the form of the oral cavity with the lower and upper jaw bone in which

teeth were set. The cavity was lined with squamous epithelium which, although embryonal in type, was characteristic of the epithelium of the oral cavity.

CLINICAL INVESTIGATION OF VULVOVAGINITIS

Dr. Irving F. Stein read a paper entitled "A Clinical Investigation of Vulvovaginitis." (Inaugural thesis, see p. 43.)

DISCUSSION

Dr. O. T. Schultz (Michael Reese Hospital): It seems to me, Dr. Stein's conclusions are justified by the work that was done. In a condition so important as vulvovaginitis and about which there are still a number of controversial points we need some criterion for diagnosis, some definite method of treatment, and standards upon which conclusions as to cure are to be based. As he said, probably smears well made and properly stained and examined by an expert are as good a method as we can demand and probably more satisfactory than cultures alone. In depending upon smears alone some positive gonococcal cases, especially the more chronic ones, will escape detection; but it is doubtful whether cultural methods will give any more satisfactory results in such cases. On the other hand, the finding of gonococcus-like organisms in the smear may lead to a positive diagnosis in a small percentage of cases in which cultural methods would establish that these organisms are not gonococci; in determining the bacteriological factors in the non-specific cases cultural methods may be of an advantage. Only 50 per cent of the cases which were positive on smear examination yielded positive cultures. This is a rather severe criticism of the cultural method at first sight, but it is hardly a fair criticism. As a matter of fact, a group of the cases which were positive on smear diagnosis and negative by culture would undoubtedly have been positive if the cultural work had been done by the bacteriologist responsible for the rest of the work; during vacation it was necessary to rely upon the aid of one less experienced in this particular kind of work.

Dr. Stein did not go into the bacteriology of his cases in detail. Of the cases which were non-gonorrhœal, he has had several interesting groups, upon which we are still working. There was one group in which the streptococcus was probably to be blamed. We have isolated several varieties of the streptococcus, chiefly of the intestinal group, which others have found to be more or less normal inhabitants of the intestinal canal. These varieties of streptococci are apparently able to produce a non-specific form of vulvovaginitis. We have also isolated several strains of gram-negative organisms which in the smear look like gonococci, but which were not gonococci culturally. We have also obtained several diphtheroids upon which work is still being done.

Dr. Joseph L. Baer: In regard to this very commendable piece of work, the essayist mentioned an epidemic which I worked up in 1904. I should like to emphasize the distinction between vulvovaginitis in children which appears in dispensary observation and that which we ordinarily speak of as the epidemic institutional variety. I believe practically without exception the epidemic institutional variety will run a maximum percentage of positive gonorrhœal types, whereas, as the essayist so well points out, dispensary material is a very diversified lot.

In this particular epidemic of 18 years ago, there were 19 cases in the hospital, and because of the difficulties with cultural methods at that time, I had to limit my cultural work to a small group, but in each of those cases the result was positive. At that time the transmission of the source of infection was finally determined to be by rectal thermometers and bed pans.

Dr. Mark T. Goldstine: With regard to epidemic vulvovaginitis, I doubt whether there is such a thing. Personally, I would not be afraid of gonorrhœal vulvovaginitis being in a ward with other clean children. I think it is a contact infection. If it were epidemic, I think we would have a great many more gonorrhœal infections under other circumstances than we do.

In regard to the treatment of gonorrhœal vulvovaginitis, it has interested me because when I was engaged in general practice I was in the Stock Yards District and saw many of these cases. They were hard cases to treat in those days, and I never felt comfortable about cures. Due to the fact that gonococci may lodge in the vulva and vagina, we should be cautious about pronouncing cures for several weeks, 1 year, or even 2 years. Outside of rape, if the infection is a contact infection and attacks the vulva first, and travels from there inward, I would not be anxious about treating cases of vulvovaginitis by introducing medication into the vagina. I would treat the vulva first thoroughly, and watch the case carefully before I would use treatment intravaginally. If the gonorrhœa has attacked the vagina and cervix, you cannot do much with instillations of silver salts. Endocervicitis is hard to cure if it is not gonorrhœal, and I do not think we can cure gonorrhœal endocervicitis with instillations of medicine into the vagina. I treat these cases hygienically outside and refrain from going into the vagina as long as I have good reason for it. In children under 4 years of age the disease is not very pleasant to treat. If the cases are treated, they should be treated by a physician, not by the mothers particularly, and if treated by nurses, the nurses should be told and shown how to do it thoroughly. Above all things, we should be careful about using intravaginal treatments at first.

Dr. Arthur H. Curtis: One suggestion I want to make in regard to determining the kind of organism is that although the majority of cases are gonococcal in origin, after many weeks or months have elapsed it is difficult to find the gonococcus. We have found also that there are at least four gram-negative types of diplococci which are extremely difficult to differentiate from the gonococcus.

Dr. Stein (closing): The idea I hope to portray in my report is that I feel that the gynecologist is the man who is qualified to take up the treatment of vulvovaginitis. As this condition is treated today, patients are shamefully neglected. The men who have taken care of these cases have had no definite idea of the disease as an entity, and they have treated it haphazardly.

In reply to Dr. Goldstine about treating these young children intravaginally, the treatment I have outlined is simple. Mrs. Shinn who gives this treatment finds after the second or third treatment the children will lie on the table quietly; there is no difficulty attending its use. The rubber tubing which is inserted into the vagina is of small size and soft, 3 inches long, and the ointment is introduced into the vagina and allowed to run over the vulva. It cleans up the vulva lesions in a few days, and the discharge disappears in a few days more.

The point Dr. Curtis made is well taken. Many of these cases that we get are not acute cases. They have been treated elsewhere and by the time we see them, the gonococci have disappeared, and that is the reason why the non-specific group is so large.

METABOLIC RATE IN PREGNANCY

Dr. Edward L. Cornell read a paper entitled "Metabolic Rate in Pregnancy." (See p. 53.)

DISCUSSION

Dr. Joseph L. Baer: The work I carried out, to which the essayist refers, was limited to normal cases. We felt fairly well satisfied that the curve we constructed represented an average scale for normal pregnancy and the puerperium. In my dead fœtus case, in the thirty-sixth week the readings were +10 before the delivery with the dead fœtus *in utero* and +8 after delivery. It is well known among workers in metabolism that a leeway of 10 per cent must be allowed for personal equation and technical difficulties, so that I feel justified in looking on that woman as having an approximately normal non-pregnant rate. The dead fœtus case to which the essayist referred showed marked variations; +35 with the dead fœtus *in utero* and +8 after delivery. That may seem a discrepancy, but I am inclined to cling to the value of the test in the presence of a dead fœtus. The essayist pointed out in his own series that he has a very definite increase which reaches the maximum at full term. He then emphasized the fact that because of puerperal activities and autolysis of the uterus, the increase is slower in returning to normal in his series than in the series I have reported. If that is true, we must accept the presence of the living fœtus at term as a cause of the considerable increase which both of us found. In my next case of dead fœtus pregnancy I hope to confirm my opinion as to the value of the test.

Dr. Charles B. Reed: In a paper devoted entirely to metabolic rate in pregnancy, it may seem a little superfluous to call attention to one item that has no bearing on the metabolism particularly, and that is the operative feature of the report. I was impressed with this point while the doctor was reading his paper, and while I do not know whether this is his regular experience or not, yet in his 84 cases he had 18 per cent forceps, 8 per cent versions, 6 per cent cæsarean sections, and one craniotomy, which makes 33 per cent pathology in his practice, which is certainly unusual. This is not counting breech cases which we refer to ordinarily as normal cases, nor does it include inductions of labor which were probably done for good reasons, though the technique was not given nor the time at which the induction was undertaken. I am curious to have Dr. Cornell explain if this unusually large pathology was customary with him or whether it happened only in this series of cases.

Dr. Cornell (closing): In trying to do this work, I will say it covered a period of more than a year, and we were only able to complete 84 cases in that time. I do not know how many deliveries I had aside from these. The cases that were completed were included in this pathological group. The women were exceedingly fearful of the test. It is a new proposition and I think Dr. Baer will bear me out when I say that it is very difficult to complete cases. One may get one reading on them, but if a second reading is attempted the patient may go into hysteria or be so nervous that the reading is unreliable. Thus in the entire year and two months we were able to complete only 84 cases. We had well over 200 cases started, so that the pathology in these 84 cases shows up markedly if you take them alone. In the 200 cases or more we tried to complete, we only found one case in which there was a fœtal death. Dr. Baer and I got diametrically opposite results. That does not prove positively that death of the fœtus *in utero* will not have the same change in the metabolic rate. In my cases the reading was taken four times because of this high rate. The work was done by the same technician throughout, except for the last 25 cases when we made a change in the technician. I do not think there was a mistake made in that particular case.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

X-Ray Dosage in Treatment and Radiography. By Wm. D. Witherbee, M.D., and John Remer, M.D. New York: The Macmillan Company, 1922.

Endocrine Glands and the Sympathetic System. By P. Lereboullet, P. Harvier, H. Carrion, and A. G. Guillaume. Translated by F. Raoul Mason, M.D., with the collaboration of Daniel R. Ayres, A.B., M.D. Philadelphia and London: J. B. Lippincott Company, 1922.

Diseases of the Thyroid Gland. By Arthur E. Hertzler, M.D., F.A.C.S. With a chapter on "Hospital Management of Goiter Patients" by Victor E. Chesky, A.B., M.D. St. Louis: C. V. Mosby Company, 1922.

A Textbook of Gynecology. By James Young, D.S.O., M.D., F.R.C.S. New York: The Macmillan Company, 1922.

Der Geburtshilfliche Phantomkurs. By Dr. med. Wilhelm Liepmann. Berlin: Urban & Schwarzenburg, 1922.

Le Radium en Gynécologie. By A. Siredey and Jean Gagey. Paris: L'Expansion Scientifique Française, 1922.

A Synopsis of Surgery. 6th ed. By Ernest W. Hey Groves, M.D., B.Sc. (Lond.), F.R.C.S. (Eng.). New York: William Wood & Co., 1922.

Mortality Statistics, 1920. Twenty-first Annual Report. Department of Commerce, Bureau of the Census. W. M. Steuart, Director. Washington: Government Printing Office, 1922.

Oto-Rhino-Laryngology; for Students and Practitioners. 2d Eng. ed. By Georges Laurens, M.D., with a foreword contributed by Sir J. Dundas-Grant, M.A., M.D., F.R.C.S. Authorized English translation of the fourth revised French edition by H. Clayton Fox, F.R.C.S. New York: William Wood & Co., 1922.

Jahresbericht ueber die Gesamte Chirurgie und ihre Grenzgebiete. Edited by Generalarzt Professor Dr. Carl Franz. Berlin: Julius Springer, 1922.

A Practical Medical Dictionary. 7th revised ed. By Thomas Lathrop Stedman, A.M., M.D. New York: William Wood & Co., 1922.

Clinical and Operative Gynæcology. By J. M. Munro Kerr. London and New York: Oxford University Press, 1922.

Index-Catalogue of the Library of the Surgeon General's Office. United States Army. Authors and Subjects. Third Series. Vol. III—Blood–Coffart. Washington: Government Printing Office, 1922.

Diseases of Women. By Harry Sturgeon Crossen, M.D., F.A.C.S. 5th ed., rev. St. Louis: C. V. Mosby Company, 1922.

A Textbook on Minor Surgery. By John C. Vaughan, M.D., and Athel Campbell Burnham, M.D. Philadelphia and New York: Lea & Febiger, 1922.

Propédeutique et Technique Urologiques. By G. Wiener. Paris: Masson et Cie, 1922.

Bronchoscopy and Esophagoscopy; A Manual of Peroral Endoscopy and Laryngeal Surgery. By Chevalier Jackson, M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1922.

The Process of Diagnosis, Including the Method of History-Taking, and Physical Examination of Surgical Cases. By E. Stanley Ryerson, M.D., C.M., F.A.C.S. Toronto: University of Toronto Press, 1922.

Selected Works of Thomas Sydenham, M.D., with a short biography and explanatory notes. By John D. Comrie, M.A., B.Sc., M.D., F.R.C.P. (Edin.). New York: William Wood & Co., 1922.

Lateral Curvature of the Spine and Round Shoulders. 4th ed., rev. By Robert W. Lovett, M.D., Sc.D. Philadelphia: P. Blakiston's Son & Co., 1922.

The Treatment of Fractures, with notes upon a few common dislocations. 9th ed., rev. By Charles Locke Scudder, M.D. Philadelphia and London: W. B. Saunders Company, 1922.

De Arte Phisicali et de Cirurgia of Master John Arderne, Surgeon of Newark, Dated 1412. Translated by Sir D'Arcy Power, K.B.E., M.B. (Oxon.), F.R.C.S. New York: William Wood & Co., 1922.

Duodecim. Kirjoituksia Lääketieteen ja Lääkärintoiminnan Aloilta. By Yrjö Kajava, Matti Wallenius, Y. E. Airila, E. E. Anttinen, Gösta Becker, J. A. Murto, S. E. Wichmann. Helsingissä: Duodecim-Seura 1921.

Sull' Epilessia Posttraumatica. By Dott. Prof. Carlo Gamberini. Bologna: L. Capelli, 1921.

Chloroform Anæsthesia. By A. Goodman Levy, M.D., M.R.C.P. With a foreword by Arthur E. Cushny, M.D., LL.D., F.R.S. New York: Wm. Wood & Co., 1922.

Brain Abscess—Its Surgical Pathology and Operative Technic. By Wells P. Eagleton, M.D. New York: The Macmillan Co., 1922.

A Textbook of Human Physiology, including a section on physiologic apparatus. 7th ed., rev. By Albert P. Brubaker, A.M., M.D., LL.D. Philadelphia: P. Blakiston's Son & Co., 1922.

Acute Cases in Moral Medicine. By the Reverend Edward F. Burke, M.A., Ph.D. New York: The Macmillan Company, 1922.

Polaris, the Story of an Eskimo Dog. By Ernest Harold Baynes. New York: The Macmillan Company, 1922.

Artificial Limbs and Amputation Stumps. By E. Muirhead Little, F.R.C.S. (Eng.). Philadelphia: P. Blakiston's Son & Co., 1922.

The Art of Anæsthesia. 3d ed., rev. By Paluel J. Flagg, M.D. Philadelphia and London: J. B. Lippincott Company, 1922.

Traité des Fractures des Membres. Dr. Henri Judet. Paris: L'Expansion Scientifique Française, 1922.

Medical Record Visiting List or Physicians' Diary New York: William Wood & Co., 1922.

AMERICAN COLLEGE OF SURGEONS

REPORT OF THE HOSPITAL CONFERENCE HELD AT THE CLINICAL CONGRESS OF THE AMERICAN COLLEGE OF SURGEONS OCTOBER 23, 1922, BOSTON

MORNING SESSION—THE PRESIDENT, JOHN B. DEAVER, M.D., PRESIDING

REPORT OF THE STANDARDIZATION ACTIVITIES OF THE COLLEGE IN 1922

BY FRANKLIN H. MARTIN, M.D., CHICAGO
Director-General, American College of Surgeons

IN presenting the fifth annual report of the American College of Surgeons, covering the survey of the civilian general hospitals of the United States and Canada, I have great pleasure in announcing substantial progress in the survey and continued enthusiasm in the work on the part of the profession of medicine, of hospital executives, and of the people.

This stupendous task, the responsibility of which at the beginning was assumed with reluctance by the American College of Surgeons, involving as it did not only the formulation of a practicable minimum standard, but also a continental survey of hospitals to ascertain how many of them already conformed to or were willing to bring themselves to conform to that standard, has now progressed so far beyond the experimental stage that the undertaking has not only been justified, but the responsibility for the continuance of the work for the betterment of hospitals is definitely fixed upon the American College of Surgeons.

The suggestion of a minimum standard was the most important of the initial tasks of the College. Briefly, it included the following fundamental requirements: (1) That the hospital staff be organized and comprised of honest and efficient legalized practitioners of medicine; (*a*) that the staff adopt definite rules for the guidance of its work; (*b*) that the staff meet at least once a month to review the work done by its members in the hospital during the previous month; (2) that accurate and complete case records be written for all patients and filed in the hospital; (3) that clinical laboratory facilities be available for the study, diagnosis, and treatment of patients.

This survey has been conducted through personal visits to the hospitals of the continent by trained medical men who have been specially drilled for this important work. The actual survey was begun in 1918, after much preliminary organization work. The 678 hospitals of 100 or more beds in the United States and Canada were the first to be surveyed, and the reports of 1918, 1919, 1920, and 1921 were exclusively concerned with the 100-bed hospitals. The surveys during 1921 and 1922 included also the 50-bed hospitals.

Therefore, the report that is presented herewith and which covers the 1922 survey, includes both the usual annual report on the hospitals of 100 or more beds and the first annual report on the hospitals having from 50 to 100 beds.

A summary of the results of the reports for the five years is as follows:

In 1918, of the institutions having 100 or more beds, 89 were found to meet the standard; in 1919, 198 fulfilled the requirements; in 1920, 407, or 57 per cent, met the standard; in 1921 the number of approved hospitals grew to 579, or 76 per cent; and this year 677, or 83 per cent, of the 812 hundred-bed general hospitals are on the approved list.

Of the 811 general hospitals having a capacity of between 50 and 100 beds, 335, or 41 per cent, are approved, an excellent showing in view of the fact that previous lists published by the College have not included these smaller institutions.

Grouping together the 1623 general hospitals having 50 or more beds, there are 1012, or 62 per cent meeting the requirements of the standard.

In closing, I wish to state that the American College of Surgeons realizes, inasmuch as it assumed the responsibility of suggesting a standard and surveying the hospitals of the North American Continent, that it is definitely obligated to continue the work until all hospitals of the

Western Continent have been given an opportunity to conform with its ideals. This we can do effectively if we continue to have the hearty co-operation of the medical, nursing, and hospital professions, and the public.

Finally, I wish to acknowledge publicly for the first time the enormous aid the College has received for the last four years from the Carnegie Corporation in financing the important program of hospital standardization. Mr. Henry S. Pritchett, the president of the Corporation (who up to the present has modestly requested that we make no public mention of their aid), has now, at my urgent request, allowed me to make this acknowledgment. The program could not have been so rapidly and efficiently carried out without the Corporation's generous yearly gift.

The program of hospital standardization which has become an epoch-making movement in the progress of medical practice, cannot be properly mentioned without giving credit to one or more pioneers who have devoted much enthusiasm and labor to the task. Foremost among these should be mentioned our former director, now Chancellor John G. Bowman of Pittsburgh University, Reverend C. B. Moulinier, S.J., president of the Catholic Hospital Association, and Dr. Malcolm T. MacEachern, director-general of the Victorian Order of Nurses for Canada and president-elect of the American Hospital Association.

THE DOCTOR AND THE HOSPITAL

By FREDERIC A. WASHBURN, M.D., Boston
Director, Massachusetts General Hospital and Massachusetts Charitable Eye and Ear Infirmary

THIS subject may be divided into two parts: (1) the hospital's obligation to the doctor, and (2) the doctor's obligation to the hospital.

1. The hospital's obligation to the doctor includes its obligations (*a*) to its staff, (*b*) to practitioners in general, (*c*) to physicians who send in patients, and (*d*) to medical students and internes.

a. The hospital should treat its staff with courtesy and consideration—it should grant their legitimate requests as far as practicable. It should make them feel that they are the strong right arm of the administration. By proper organization of an executive committee the staff should be made responsible to the trustees for recommendations of professional policies and staff nominations.

b. The hospital and its staff should share with practitioners in general the advantages which accrue to the fortunate individuals who are on the staff. The hospital may place at the service of local physicians the resources of its X-ray, metabolism, cardiological, chemical, and pathological laboratories in so far as it can do so without interfering with its own work.

The hospital may also give courses on certain days a week which may be attended by practitioners of the neighborhood. Here in Boston such courses have been very successful and much appreciated. They have been chiefly a comparison of clinical and pathological findings with a demonstration of pathological material. Leaders in this work have been Drs. William H. Smith, Oscar Richardson, and Richard C. Cabot.

The general practitioner always has patients with obscure maladies for whom he needs consultation and advice. He wants laboratory and X-ray examinations and, perhaps, the opinion of several specialists. For the rich, these things are provided by admission to private wards and hospitals and in the offices and laboratories of specialists. The poor have the wards and out-patient departments of our general hospitals.

The Massachusetts General Hospital has tried to provide a clinic of consultation for people of small means. Twice a week in the afternoon this clinic is held. Representatives of all professional departments are present. A small fee is charged. The money goes to the doctors after the hospital has been reimbursed for its extra expense for this clinic. Patients are admitted only upon recommendation of a physician. A report of findings is sent him at the conclusion of the examinations. It may be necessary for the patient to come a number of times but no second charge is made. Small laboratory fees are necessary. The patient is referred back to the physician. No treatment is given. The hospital has received repeated assurances from physicians using this clinic that it has been of great help to them in their treatment of patients of small means. The physicians upon the staff have given freely of their services to this clinic. The recompense is meagre but they have felt that they owed this service to their fellow practitioners less fortunate than they in hospital affiliations.

Service to the physician on a broader scale may be exemplified by the case records published by

the Massachusetts General Hospital and edited by Drs. Richard C. Cabot and Hugh Cabot. This publication is sent throughout the civilized world and is of benefit not only to physicians who have access to hospitals, but to many an isolated practitioner in the remote wilderness.

c. How can the hospital help the physicians who send patients to it? The administration must see to it that all inquiries and applications are treated with courtesy. The admitting officer must try to put himself in the place of the harassed doctor at the other end of the telephone. He cannot grant all requests, but he can and must show the hospital's desire to co-operate.

After the patient is admitted, there are many courtesies that the hospital can show the physician who referred the patient. The physician should be notified by telephone of the time of operation. If the patient dies and an autopsy has been granted, the physician should be notified when it will take place.

Upon discharge of the patient, a letter may be written to the doctor giving a brief summary of the case, discharge diagnosis and, perhaps, suggestions for future treatment.

When a physician has referred a patient to the out-patient department a letter should be sent to him stating the diagnosis, and if he is sufficiently interested to make further inquiry, an abstract of record or other information should be sent him without charge. All this involves considerable expense and much work but it is an obligation to the physicians sending patients to the hospital. The institution is amply repaid by the kindly feeling thus gained for it.

d. The obligation of the hospital to its internes and medical students includes their education and training. This is so essential a part of a hospital's duty that I need only name it. The hospital must be sure that its internes receive at least a fair equivalent for the time and labor they give. Careful instruction should be given them and every effort made to see that they get the most possible from their service. The hospital will be repaid by the improved character of house officers and by the possession of a fine loyal alumni.

There will be found few today to question the value of teaching to a hospital. It means keen, alert work in diagnosis and treatment. Fortunate is the hospital which has it.

We must see to it that students receive under proper restrictions every facility to acquire knowledge. It is best to make them as far as possible a part of the machine. This is the hospital's obligation to the medical student—the doctor of the future.

2. The second phase of this subject deals with the duty of the doctor to the hospital. By the very nature of his work the physician is an individualist. He works by himself or with a few others. He does not rub shoulders with the masses of men as does the business man. He is the autocrat of the sick room and if a surgeon, he is commander of the operating team. Hence, to work in the organization with many others is difficult for him and team work of the hospital staff is necessary if results are to be obtained.

The successful doctor meets with something like worship from his patients, especially the women and perhaps from his house officers, medical students, and nurses. Under these conditions we sometimes find a surgeon loses his sense of proportion. If he has not a well developed sense of humor he may even take for fact the estimate of him made by these youthful and exuberant partisans. Such a fault brings its own retribution. No one suffers like the vain man. He continually sees slights of his own importance and is always in trouble because of them.

Physicians do not take kindly to discipline. This is because they are individualists. I have known members of the staff to defy authority and state publicly that they would do certain things in spite of the well considered regulations laid down by the executive committee of the staff, trustees, or the director. Such action, of course, can only result in the confusion and humiliation of the perpetrator.

Speaking roughly or rudely to nurses has in the past been a habit with some men, particularly surgeons in the stress of an operation. If a man appreciated how it reacts against his own reputation we should soon hear no more of it.

I have known members of the staff to speak of the administration of the hospital in a disrespectful manner before house officers, nurses, or students. This cannot be ignored, for from it grows insubordination and contempt of authority.

With all their faults I wish to record my belief that among the physicians of a community you will find the highest ideals, the most generous motives, and the kindest and fairest treatment of their fellowmen of any group, bar none. In the two hospitals of which I have the good fortune to be director, I have met with the most cordial co-operation from the staffs. The team work has been good. The faults which I mention have been met only occasionally.

The physician appointed upon a hospital staff has an obligation to give adequate time and the best service that is in him to the hospital. He draws good from his service only in proportion to

the work he puts into it. A hospital service should mean to a man the opportunity to perfect himself in his profession. If he is a surgeon, he becomes manually expert and improves his surgical judgment. If he is a physician, he sees many more patients at the hospital than he would outside and thus his clinical experience broadens. He comes into contact with other keen minds, and slovenly work is not likely to be tolerated. Service to his fellowman is expected of every physician worthy of the name. The profession is not yet seriously tainted with commercialism. The member of a hospital staff has an opportunity to do much good for humanity. This may be in the actual care of patients, laboratory or research work, and the wise counsel or loyal support of those who are trying to make the hospital a success. Members of a hospital staff who are using their position simply for their own financial gain, or to increase their prestige, are of no use to the institution and should be driven from its sheltering arms.

The present hospitals of the country are in a transition period of staff organization. We have always known that between members of the staff of equal ability a man's value to the hospital is determined by the time, work, and thought which he gives to the hospital. As the complexity of methods of diagnosis have increased and as the difficulty of keeping in touch with others' progress increases,—not to speak of making progress for oneself—it has become more and more difficult for the busy practitioner to be on the hospital staff and give the hospital the sort of service required today. From this fact has developed the full-time or paid part-time hospital physician and surgeon. This is a development in the right direction because it gives to the hospital, time, work, and thought and continuity of planning and effort which the busy practitioner can never give it. On the other hand, I wish to record my firm belief that the hospital will always need on its staff for the direct care of its patients, men who earn their living in the practice of medicine and surgery; but only such men will be needed by the hospital as are willing to make a very definite monetary sacrifice so that they may give it an abundance of time. Such a man should take his reward in his increased prestige, the fact that this connection makes him a better physician or surgeon, and in the satisfaction of forwarding the interests of the leading factor for good in our modern civilization —the great hospital of the community. The legitimate line of progress in the future would appear to be that all important professional services will be headed by men paid by the hospital for a large part of their time; that under them will be a group of paid men whose time is devoted to considerable extent in teaching and research; but that working with these men and with their rights zealously guarded by the hospital will be the unpaid practitioner who is willing to devote considerable time to the hospital work.

It is an unfortunate fact that there are physicians in considerable numbers who have never received the requisite training, but who are trying to do surgery. To many of our people a hospital is a hospital and any doctor is a surgeon. A way must be found to protect these people. There should be some recognized mark of the competent surgeon and the trustees of all hospitals could then forbid others to operate in their institutions. The private commercial hospital would probably require state regulation.

A hospital must have autopsies if it is to check up the cause of its failures. The family physician can help the hospital there more than anyone else, and in aiding the hospital he adds to his own information.

It sometimes happens that the wrong diagnosis is made or the wrong treatment undertaken at the hospital. The hospital would be helped if the physician would send the patient back or write a letter calling attention to the error as it becomes clear.

In general, we may fairly say that if a hospital is doing its full duty, there will be no difficulty about its receiving the loyal support of the physicians of the community.

Without a good professional staff composed of able, unselfish men, a good hospital is impossible. Without a good hospital, correct medical teaching, progress in medical science, and good care of the sick cannot be had.

We should, then, support the work of the American College of Surgeons which is making a notable contribution toward better surgeons, better staffs, and better hospitals.

THE MINIMUM STANDARD AND ITS APPLICATION TO HOSPITALS

By FREDERICK W. SLOBE, M.D., Chicago
Hospital Standardization Department, American College of Surgeons

DURING the past decade an increasing attempt toward standardization in all fields of human endeavor has been apparent. At first, in certain respects, standardization in medical and hospital activities did not keep pace with its development in other lines. The American College of Surgeons, in its hospital standardization campaign, endeavored to correct this shortcoming. The application of the minimum standard to hospitals, in essence, means the closest correlation of all medical and hospital efforts, and the highest degree of mutual cooperation between each individual associated directly or indirectly with hospitals.

Personal contact furnishes the best index to the application of this standard. Our hospital surveyors, during personal visits to 1600 of the general hospitals in the United States and Canada, have had certain observations impressed upon them so repeatedly that a brief enumeration of these impressions seems warranted.

The staff situation involves so many angles that it is difficult to approach it in so short a space of time. There is no standard type of staff organization applicable to all hospitals. Local variations demand varied types of organization, hence it is for each hospital to decide which type best meets its individual needs. There should be, however, a definite organization, including the formation of sufficient committees to cover the various activities of the hospital, in order that responsibility for these activities be accurately centralized. In this connection, the greatest difficulty exists in the small hospital in the small community, where the entire medical personnel of the community use the hospital. In such instances, it may be wise in the beginning to include on the hospital staff all the ethical practitioners in the community, all of them being expected to attend the staff meetings and to co-operate with the hospital in its efforts to improve. Later, various modifications and improvements in the staff organization may be instituted. A too radical or partisan arrangement of the staff in the beginning may definitely retard the subsequent development of the organization.

Another difficulty exists in hospitals which have a large list of so-called "courtesy" staff members in addition to their "regular" staff. These physicians, who utilize the hospital only occasionally, are often less interested in its progress. Even though they use the hospital at infrequen intervals, they should be expected to live up to al the obligations which the hospital expects of its regular staff. The "courtesy" staff members should be informed at frequent intervals concerning the requirements of the hospital, that they are a part of the hospital so long as they send any of their patients there, and that they are expected to attend the staff meetings.

The analysis of hospital results is one of the chief objectives of the standardization program. Much confusion still exists concerning methods in which this should be brought about; naturally, the same method may not be applicable in all hospitals. The College features the regular monthly staff conference because it is the means by which the analysis is best undertaken in the vast majority of hospitals. It is indispensable in nearly all institutions; in only a small percentage can it be considered impractical, notably hospitals with a staff of only one or two physicians where a formal conference is, of course, out of the question. Whether departmental conferences or combined meetings are held is immaterial so long as the various activities of the hospital are covered.

Teaching hospitals closely affiliated with medical schools and certain group clinics connected with hospitals may undertake thorough analysis of their work; the former by a presentation of patients before students and the latter by a close association of the physicians. Even in such institutions, however, there is no question but that there are many occurrences of great clinical importance which lose much of their educational value by failure of being brought to the attention of the entire staff. The group clinic, therefore, should have a regular résumé of its results brought before its staff. The hospital of only two or three physicians should conduct a similar, though more informal review, and the teaching hospital may well bear in mind the added impetus which an analysis of this kind may bring about.

It is the feeling of the College that a large part of the monthly staff meeting should be devoted to an analysis of the casualties including the deaths, infections, complications, unimproved cases and in fact, anything closely related to the clinical work in the hospital. The discussion is impersonal, being a study of certain results and the relationship of those results to the hospital. An

attempt at humiliation should not be countenanced; a clear, straightforward, educational discussion, however, will not invoke antagonism. Our failures are the greatest assets in the light of our experience if we only face them squarely.

Hospitals with a large list of "courtesy" staff members have difficulty in deciding whom they should expect to attend the meetings. Many hospitals solve the problem by inviting all to attend but *requiring* the attendance of those who have had patients in the hospital during the preceding month. Some physicians with multiple staff appointments object to the staff meetings, stating that too many of their evenings are thus occupied. It is uncommon to find many physicians who are extremely active in more than two or three hospitals and they should be willing to devote two or three evenings a month to their hospital affiliations. If they are connected with many other hospitals, it is usually in a consulting or relatively inactive capacity which would not require regular attendance.

Relative to case records the hospital is the logical repository for the medical history of a community. Physicians' office records often are so meagre and varied that they cannot be depended upon to supply complete information in time of need.

If hospitals have deficient records in spite of a sufficient number of internes, it is due to the fact that the internes are not performing their duties because of lack of supervision on the part of the administrative and professional staffs. The available number of internes is insufficient to supply the demand, hence, record clerks or historians are needed. Some hospitals which have only a part-time historian fail to realize the many functions of a case record department. In the future every hospital of twenty-five or more beds will have at least one full-time record clerk. At present many hospitals find it satisfactory to utilize part of the historian's time in other activities of the hospital.

In the cities a not uncommon difficulty exists in certain hospitals used almost exclusively by physicians who have studied their patients thoroughly in their offices, have had a large volume of diagnostic work performed outside, and bring the patients to the hospital for operation or treatment only, failing to realize the necessity for furnishing the hospital with the records. Such physicians often keep good office records; if so, the hospital should be sent copies; if not, the physician should co-operate with the efforts of the hospital to secure accurate records for its files.

A very common deficiency in hospitals which have recently instituted record systems is a very brief, stereotyped form of case record which seems to fit about 80 per cent of the patients and gives one very little knowledge of the diagnosis. In most instances this is due to lack of staff supervision of the internes, record clerks, and of the records themselves. Operation records are notably weak in a complete description of the exploratory findings and operative technique. In order to insure accuracy they should be dictated or recorded during or immediately after all operations. Each physician is responsible for the record of his patient even though most of the labor may be relegated to an interne or record clerk. If so, the physician should take sufficient time to insure the accuracy of the records. This will save him subsequent embarrassment, as well as insuring the patient and the hospital accurate reports for future reference.

Sufficient space for the record room, conveniently located, must be available; in order to be used frequently and accurately, records must be immediately accessible. This means good filing cabinets and cross indices for name and disease. Whether filed in groups by disease, or filed numerically is immaterial so long as the record can be obtained immediately. There is no standard disease nomenclature which is used by all hospitals. At the present time, therefore, the *International Classification of Diseases*, published by the Bureau of Census, Department of Commerce, Washington, D.C., and other well known disease nomenclatures are being utilized.

Another great omission in hospitals consists in failing to make adequate use of the records. After expending a great amount of time and money on the records, it is a great economic as well as an educational loss if records are not utilized to the fullest extent. By using the records, I refer chiefly to the analysis of hospital results mentioned in connection with the staff meeting and with the work of the record and program committees. After a hospital has a complete record department, material of great statistical value will become available to an increasing extent each year. This will be particularly true when hospitals adopt more uniform nomenclatures so that their statistics are uniformly comparable.

The question of laboratory service involves varied interpretations according to the size, type, and location of the hospital. Each hospital should have a laboratory of its own for the performance of the usual routine examinations, such as various chemical, microscopic, and bacteriological analyses. Naturally, the more technical tests may have to be performed outside as the available number

of serologists and pathologists is not sufficient to supply each hospital. This applies especially to the hospitals in the small communities, in which the service is considered satisfactory if an adequate number of specimens is sent to competent laboratories.

Technicians should have adequate supervision either by a part-time pathologist who visits the hospital at regular intervals, or by some staff member, fully versed in laboratory technique and interpretations. Some hospitals with the most complete laboratory equipment perform fewer tests per patient than hospitals with relatively meagre equipment. Laboratory service, therefore, is not always proportionate to the laboratory facilities themselves. This discrepancy is often due to the system of laboratory charges and affects particularly private patients where a separate charge is made for each test performed. There is often a hesitancy on the part of the physicians to prescribe certain laboratory tests if they realize that a separate charge will be made each time. This can be obviated first by the adoption of a flat-rate fee, to include the usual laboratory examination, or no fee at all may be charged if the cost of the laboratory is determined and subdivided by adding a certain charge to each room or rate per day. The hospital then can insist upon a certain laboratory routine without adding each item to the patient's bill. Tissue examinations must be included in this, in order that the hospital may have every specimen sent to the laboratory. This should be as rigid a part of the operating room technique as the sterilization of instruments. As many specimens as possible should be sectioned, and every specimen should have a least a gross pathological report.

In addition to the almost universal routine urinalysis, however, the routine hæmoglobin estimate and leucocyte count are becoming increasingly prevalent. These, in addition to a routine examination of tissue, serve as a good basis for a minimal, routine laboratory requirement. Physicians should be encouraged to a more routine use of laboratory facilities in the hospital.

In roentgenological laboratories, the problem of adequate interpretation is a serious one, as there is an insufficient number of trained roentgenologists to supply the demand. Here also the question of supervising the X-ray technician is important. A roentgenologist should be in charge of each X-ray laboratory, even though he spends only a few hours each day there for the interpretations. The responsibility of these interpretations should be in the hands of one man, a trained roentgenologist. If left to the various physicians, the patients will not get uniform X-ray service.

The principles of the minimum standard have been adopted by over four-fifths of the general hospitals on this continent. A progressive improvement in hospitals is everywhere apparent; but there is need for a closer insight into the real meaning of these principles. Let us hope, therefore, that each hospital superintendent, each member of a board of trustees, and each physician will see more clearly his individual obligation and responsibility and that the increased co-operation resulting therefrom will bring about a fuller realization of the spirit embodied in the application of the minimum standard.

WHAT REAL AND LASTING BENEFIT HAS COME TO THE PATIENT FROM HOSPITAL STANDARDIZATION?

By Reverend CHARLES B. MOULINIER, S. J., Milwaukee
President, Catholic Hospital Association

THIS is a rather presumptive topic for a layman to have chosen and yet it is only a variation of the theme I have been talking on to medical men and hospital people ever since I have been associated with the American College of Surgeons in its program for standardization.

We must understand standardization thoroughly and deeply in order that we may appreciate whether or not it is anything real and of lasting benefit to the patient. Standardization is an external means of making things in the hospital and the work of the medical, nursing, and hospital professions more or less uniform. It is laying down rules for the conduct of the hospital, for the conduct of meetings of the staff, for the making of records and for the equipment, manning, and using of the laboratories. It is inevitable that any form of standardization should aim at some kind of uniformity. What I shall say to you grows out of my experience with the College and my observations of the great body of Catholic hospitals in charge of Sisters, some 674 on this continent, with something like half the bed capacity of all the general hospitals, and also out of the observations I have been able to make in regard to other hospitals.

This external standardization is accomplishing great things. The number of hospitals that have been put on the College's approved list is growing rapidly. All this indicates an eagerness on the part of the medical profession and of the hospital people to be on that desired list. However, it is not being on the list, it is not being surveyed and pronounced by the surveyor as fit for the list, that makes the hospital an actual agency to give every patient that which the standardization program has purposed. We all know that the aim of the standardization movement of the American College of Surgeons is to benefit the patient, but it is not going to benefit the patient, no matter what external form of standardization may be brought into the institution, until the medical profession, the nursing profession, and the hospital people actually and physiologically function as a unified institution for the purpose of helping each particular patient.

This movement is bringing about a closer coordination of laboratory and clinical medicine. The movement is making the medical man a better diagnostician and improving the results in all fields of medical practice. As fast as human nature will permit, it is obliterating the distinction between laboratory and clinical medicine. It is focusing the mind of the managing personnel of hospitals upon the importance and the fundamental character of diagnosis, and as the diagnostic ability of the surgeon, the internist, and the pathologist improves, of course the patient is benefited. As a result, the medical mind is becoming more thoughtful, more anxious, and more reserved in its diagnosis, the surgical mind is holding back surgical therapy until the diagnosis is as clear and sure as modern medical knowledge will enable it to be, and I believe that the number of operations is being reduced, and that those which are performed are done with greater skill, with greater caution, and with more finished technique, with the men performing them more thoughtful, more careful, and more conscientious. If this be true, that the surgeons are really lessening their work and improving the work that they do, what a credit, what an honor it is to the American College of Surgeons for having instituted such a movement. What a credit and honor for all those other bodies which are gradually coming to realize that this movement of the College is a genuine one, a scientific one, an unselfish one; one that is bringing to the patient what the patient had a right to—the best scientific, the most conscientious, and the most highly human service that the medical, nursing, and hospital professions are capable of giving.

Is there still room for more of these higher qualities of science, training, and care to be interjected into the so-called standardization movement? By all means. The defects of the profession of the present are just along the very lines which standardization emphasizes: organization, records, and laboratory service. The medical mind is an individualistic, scientific mind. But that does not mean that it may not be a get-together mind; that it may not be a more conscientious group mind; and that it may not be a more hearty and lofty character which puts aside all those selfish, petty, individualistic characters which are not a credit to the individuality or to the profession.

I am going to venture to say to you that the medical profession today is a profession greater in character, has developed greater individuals, is at least in its solidarity as a profession more conscientious than it was five years ago when this movement began, and is working closer with the nursing profession and with the hospital authorities than it ever did before. They are working in the open daylight; they are working with one another. The day when an individual doctor could do as he might be prompted to do and take a patient to operation without careful, considerate diagnosis and operate as he pleased with closed doors is practically gone. It exists here and there. Therefore that first essential of the College, organization, necessarily brings about the association of all those concerned with the patient so closely that individual weaknesses, individual limitations, and individual pettiness are bound to disappear.

The case record is one of the elements which is making the medical profession more careful and more thoughtful and here, also, lies one of the greatest needs for improvement. You cannot leave the making of the record to an interne, to a secretary, or to a historian. You can ask them to help you and wherever they can they should help you, but the final balancing of the facts into a safe, scientific diagnosis must come from the trained medical mind alone; and the older and better trained that medical mind is, the better. Until every one of the medical profession realizes this and is willing to assume the difficult task of being back of the record, just as he is back of the therapy that follows, the sooner will this wonderful standardization movement mean more for the patient in real and lasting benefit.

THE AMERICAN HOSPITAL

By A. R. WARNER, M.D., Chicago
Executive Secretary, American Hospital Association

ONE particular hospital may seem to be a comparatively fixed and established organization, but the American hospital as a national program of public service is a rapidly changing institution. This paper aims to place before you a few comments on present drifts, trends, or policies from angles other than the usual professional viewpoint.

Conceptions of the hospital as a form of charity and as an organized assistance to physicians in their work are now quite *passé*. The progressive hospital aims to be a factor in the public health and the medical service of the community and to make a positive contribution to the future medical and health status of the nation.

But the penalty for activity is responsibility. Just now the American hospital is in the process of finding out the responsibilities it has assumed by asserting itself and assuming an independent identity. The information is coming through Supreme Court decisions, through public demands and expectations, from the just appeals of the leaders in medical, nursing, and social service professions and from the findings in public health studies. Without question a greater responsibility to humanity, to the political state, and to the individual patient has been assumed and must be met. This does not imply any lessened or even modified personal responsibility of the physicians practicing in the hospital; rather it is new and distinct.

The American hospital, and this means a larger group than the university or teaching institutions, is assuming direct and full responsibility for the professional care of patients. No other interpretation can be placed on the admission of a ward patient. The hospital contracts to furnish the professional as well as the accessory service. The right to assume such a contract and to execute it through professional agents is not questioned. Court decisions are now quite generally (Massachusetts is, however, an exception) holding the hospital responsible for the patient to the extent of the exercising of due and proper care in the selection of agents, specifying as such "physicians, nurses and other attendants." The arguments assert that the hospital can and should know as to the competence of these agents, but it can not follow their every act.

In several cases personal damages have been collected by patients from hospitals, causing more uneasiness than is justified. The decisions are based on only two points: first, the universal principle that the hospital, as all individuals, must be just before it be generous; and second, that due and reasonable care must be exercised in the selection of agents. To this much the public clearly is entitled. This uneasiness will not affect good hospitals and will (as it should do) make poor hospitals better.

Attention is also attracted to the fact that the recent court decisions are pointedly neglecting any consideration of such points as whether the patient in question was free, part-pay, or full-pay, whether a ward or private patient, or how the medical attendant was selected. They seem to assume that the hospital acted as a responsible principal in a public service capacity and that all who ministered to the patient while in the hospital were its agents.

The proposal that hospitals revert back to the policy of assuming to give only bed, board, and accessory care was not long ago given wide publicity, but it brought no response other than condemnation. The American hospital is to stay a medical institution and face its assumed responsibilities.

All this makes the formulation of any standard, however limited in scope, of great value to the field. The hospitals were slow to recognize the value and benefit to them from the formulation and urging of the minimum standard by the American College of Surgeons. At first the standard seemed too closely restricted to the professional activities. All of it does deal directly with professional conduct, but as the professional responsibility of the hospital became better understood and accepted, the application and value of the minimum standard became more thoroughly realized. The Catholic Hospital Association first gave it support. Later the American Hospital Association officially endorsed it without reservation, and today it has our unqualified support. Any hospital not meeting this standard now keeps still about it, for it has become a measuring stick of recognized units.

That the specimen removed at operation belongs to the hospital and not the patient or surgeon has become an established principle and practically universal practice. But do we yet fully realize the obligations and responsibilities

this places on the hospital? The leading motive behind the establishment of this decision was, of course, the protection of the hospital. But ownership of the specimen cannot fail to carry with it the responsibility to use it for the benefit of the patient, for the promotion of public health, and for the progress of the medical sciences. All this is in harmony with the development of the hospital as a responsible medical institution and a part of it, yet these responsibilities are so often neglected. Laboratories and medical research are not maintained entirely for the patient, for the staff or the student—they are essential to the hospital in the proper meeting of its assumed responsibilities.

In one policy the American hospital seems to be fixed. This policy is its allegiance to the cause of scientific medicine. There has been no wavering. Last year the legislatures of several states passed bills requiring that any hospital in order to claim tax exemption must admit the patients of any person licensed by the state to practice any form or any part of the healing art and under the full control of such persons. None of these was signed by a Governor or became a law. There will be more of these bills this year to fight, but fight them we will. The sustained verdicts against hospitals have become the protectors of hospitals. If the Supreme Court of a state holds the hospital responsible for the exercising of due and reasonable care in the selection of its agents, specifying physicians as agents, hospitals must be granted the right to select these agents, the right to appoint a staff and the right to decide who may and who may not treat patients within the institution.

The organized staff requirement of the minimum standard has the universal support of the hospital groups and the indorsement of all the progressive elements of the medical profession. It is also in harmony with court decisions and principles established thereby. It must be about right.

HOSPITAL STANDARDIZATION FROM A PUBLIC HEALTH STANDPOINT

By D. A. CRAIG, M.D., Halifax
Provincial Commissioner, Nova Scotia Division, Canadian Red Cross

THE basic principle of all our public health work is the prolongation of human life and the increasing of human efficiency. Consequently, no public health work can hope to attain the maximum of success which does not have in co-operation with it the medical profession and our hospitals. You might as well try to run a railway without a department of repair and a department of research as to run a public health campaign without a hospital. You might as well try to run a railway without engines and without engineers as to work for public health without the co-operation of the medical profession and those of us interested in hospitals. There has been expressed in several parts of this continent the idea that we as a medical profession and we as hospital people are not interested in public health; that we are only interested in people who are sick so that we can make money out of them. It is up to us as members of the medical profession to prove to the public that we are interested in public health not simply by showing or saying that we will do this or that but by taking the leadership in public health and by proving to our people that we are interested in it and are willing not only to co-operate but also to be leaders in the great movements for public health, better health, better hospitals, and for better public service on the part of our medical profession. Every human being, whether he likes it or does not, is an asset or a liability in the community in which he lives. And our hospitals should return to each community, for the community investment, dividends in restored human efficiency and economic value.

I sometimes wonder if we should not sit down and consider whether our hospital this year has returned a sufficient dividend; whether in our hospital we have done all we could to see that those dividends were the highest possible, to see that we have done better this year than last. And now, if you do not remember anything else that I may say to you this morning, there is one thing I want you to remember, and that is this: *Our hospitals owe to future generations records of present experiences.* I want you to take that home with you, put it in the record room of your own hospital and in your own office, and remember that we owe to future generations records of present experiences.

Do you ever realize that we recognize the old masters today by the records they have left behind them? All our medical knowledge has been based upon records of the past and surely we will go on with that structure, building upon firm foundations for future generations to benefit by and build upon further. Now, whether you have recognized it or not, we have never realized before

how essential records are to a hospital and it is up to us to go home after these meetings, with a little more enthusiasm and interest, and to insist that we have as good hospital records as we can have, so that we will lay the foundation for the future, and future generations will bless us because we have given them the records of our present experiences.

We sometimes hear people say that the modern health ideas are all a fad and folly and that this hospital standardization program is just a fad of this American College of Surgeons. They may not see in it the move for better public health on the part of the medical profession and those interested in hospitals. To those people who would object I will say this, there is absolutely no use in throwing bricks at the sunrise for the dawn will come just the same. We have in this hospital standardization program a wonderful opportunity for public service. In our hospitals we have an opportunity to teach health and to take a part in the great campaign for health education, getting people willing to be healthy. You cannot legislate a man to be healthy, but you can teach him to be healthy.

In some of our textbooks we have chapters on anatomy and physiology, and the little folks do not know what they mean. We do not care whether the child thinks his stomach is in his body or not provided he knows when to eat, how to eat, and what to eat. And that is the kind of information we are trying to put over in our hospitals and we seek to prove to people in this country that we are interested in public health and that we are interested in their welfare, in attempting to prevent human illness and to prolong human life.

Now, let me ask you to put your enthusiasm into it, put your muscle into it, put your backbone into it, and realize that this program means a tremendous amount not only to you personally but to the community in which you live. Spread your enthusiasm to everybody in your hospital, even to the board of trustees, so that your hospital will be better this year than last, and that you will have a stronger influence in the community in which you live.

SIDELIGHTS ON HOSPITAL STANDARDIZATION

By Mr. ROBERT JOLLY, Houston
Superintendent, Baptist Hospital

I DO not know why I was given the subject of "Sidelights," but I would say that the important lights that I come in contact with in the hospital are these:

First, the lamp light represented by the patients, whose lights are flickering and dim and nearly ready to go out.

Another light in the hospital is the incandescent light, in other words, the folks who help to make the hospital go. Day and night, twenty-four hours, straight running, these lights are burning, in the operating room, delivery room, laboratory, history room, and everywhere. They do not make much noise, and they are not very large, but they are always active and ready.

The directors I would liken to arc lights. They are the big lights but they usually hang about outside. They are fine to have around but they do not shine but half the time. Out on the street when things get dark, the arc lights are turned on. So it is in a hospital; when things get dark and stormy we call on the directors and they begin to function.

The other light is the searchlight and you men of the medical profession are the searchlights. You keep prying around into places and asking questions. You search out the history of the patient before operation; you search out the patients themselves and you search again after operation. You are searching and re-searching all the time and we cannot get along without you.

I believe the greatest single factor for the protection of the patient is the minimum standard evolved by the American College of Surgeons. It is the testimony of hundreds of hospitals everywhere that it has been the greatest stimulus toward better service and closer co-operation among the factors in the running of a hospital that has ever been known.

Without co-operation it is impossible to run a hospital. I would say that the man upon whose shoulders falls most heavily the task of eliciting co-operation is the superintendent. I think I can best illustrate his position by my hand. Consider the thumb as the superintendent of the hospital. Consider my first finger as the patient, the second finger as the staff, the third finger as the board of directors, and the fourth finger as the associates of the superintendent. You will readily see that the superintendent's task is not only to co-operate with each of these four groups but to get each of these four groups to co-operate with the others.

That is no small responsibility but, in my experience, the minimum standard has been an inestimable help in doing this very thing. When a patient comes into the hospital he is likely to object to his history being taken or to the pathologist making his laboratory test. But when it is explained to him that he is in a standardized hospital and that, for his own protection, it is necessary to make these tests before he is operated upon or before any treatment starts, he usually sees the wisdom of it and begins to pride himself upon the fact that he came to a recognized hospital.

Sometimes the patient objects to a flat-rate charge for laboratory work, contending, many times, that a patient ought to be charged for just what he has received instead of an equalized rate for everyone. When they come to me about this I remind them that two of them get on a street car and pay the seven-cent fare. One of them rides three blocks and the other rides three miles; yet both are contented and do not dispute with the street car company. That usually satisfies them.

The minimum standard has already wrought wonders in the staff work of the hospitals. In many hospitals before the standard was set up, the staff meetings amounted merely to a social gathering where nothing of any real value was done and where the meeting usually broke up with wrangling. Now, however, the men know that in order to keep the hospital up to the standard, they must do a definite work at their monthly meetings, must go over the records of the hospital, and that man who has had a mortality among his patients must explain why. They also have found that each man, instead of being a star, is one of a team, and that he can count on all of his fellow workers to give him their best judgment. And so they have learned to work together.

In our own hospital, the staff has recently sent an invitation to the superintendent of the hospital, the superintendent of nurses, and their supervisors to meet with them each month for the first thirty minutes to go over ways and means for increasing the efficiency of the hospital. Not only that, but they have appointed an efficiency committee which meets with an efficiency committee of the board of directors to seek suggestions for the betterment of the hospital.

New light has come to many boards of directors as they have found that the minimum standard is something to be proud of. It is amusing but gratifying to go to many places and see the directors priding themselves on the fact that they now have a standard hospital. They have now learned that they are more than a finance committee and that they are absolutely responsible for everything that goes on in that hospital. They have found, too, that it makes a vast difference who operates on patients and that an operation is not the first resort, but the last. Since they are finding this out they are a thousand times more careful about who to put on the staff, for, if their hospital has already attained the minimum standard, they do not want to drop back and, if they have not attained it, they are putting forth every effort to do so.

The hospital superintendents over the country are finding that the spirit of the standard is getting into the hearts of their associates in management. When questions arise they are now being solved in the light of the minimum standard. In our own hospital we have a weekly council of all those in the employ of the hospital. We never have a meeting but that some question arises and in trying to solve it somebody will say, "Now, remember the minimum standard says so and so, and we must be careful about that."

I find that associates in hospitals are taking a great deal more care to explain to the patients and to the visitors the "why" of the records and the laboratory work and other things that are made necessary by the standard. They go to great pains to explain to patients coming from outside that we cannot allow just anybody to come in and operate for we must vouch for the work done by every man operating in the hospital.

So I say that the minimum standard is not only arousing enthusiasm in each one of these groups and giving them a new vision of hospital work, but it is bringing them to a point where they cooperate better than at any time in the past.

We must use as much sense in running a hospital as the large corporations are using today. We are grateful that so many hospitals of 100-bed and 50-bed capacity have already attained the minimum standard and we are looking forward to the not far distant day when all of them can hit the mark and then the standard will be raised a little higher and we will all go after that.

THE ANALYSIS OF END-RESULTS

Joint Discussion

By EUGENE H. POOL, M.D., New York, and E. A. CODMAN, M.D., Boston

Dr. Eugene H. Pool: By end-result we mean the ultimate outcome in operative cases in respect to general health, symptomatic relief, anatomical condition of the parts affected, and economic efficiency of the patient, especially the period and degree of his disability.

By analysis of end-results is meant primarily the grouping and study of the results in types of cases and operations.

To obtain these facts a system is essential entailing some labor and expense. The natural query is whether the results justify such outlay. Let us first outline some of the advantages of an end-result system and analysis and then describe the details of a system by which end-results are obtained: an answer to the query may then be obtained by balancing the credit and debit columns.

Advantages Accruing from an Analysis of End-Results

The patient. Early and regular observation and examination of patients often results in timely and prophylactic advice as well as the early recognition and correction of failures or complications. Take, for example, an incipient hernia in an appendiceal wound. Such incisional hernias if left to the patient's impulse, often become large and difficult to close before advice is sought, whereas timely repair is extremely simple and reliable. Again, early recognition of a recurrence in carcinoma at times affords the possibility of prolonging life and comfort. Such types, which could be multiplied almost indefinitely, are met with extensively in the routine examinations of a follow-up clinic. The patients not only profit greatly but appreciate the interest shown, as is evidenced by the regularity of their visits.

The surgeon. The knowledge of the results of types of operations and the amenability or resistance of various lesions to surgical efforts is of inestimable value to the surgeon. The most effective, far-reaching instruction is derived from the grouping and analysis of an accumulated mass of these cases. The failures are often disheartening because exact figures give to the failures a far more conspicuous place and a far higher percentage than is derived from impressions. Memory is not relied upon and convenient forgetfulness is impossible. Yet such truths stimulate the conscientious worker and show him his weaknesses. His work from year to year as a result becomes more reliable and careful, his usefulness being proportionately increased. We will mention two groups which have been studied on the Second Surgical Division of the New York Hospital.

Hernia. The analysis by Dr. Seward Erdman of a series of 1000 consecutive inguinal hernia operations has occupied a period of about five years. Eighty-nine and five-tenths per cent of the total operations were adequately traced. The number of return visits and examinations averaged 2½ for each case and ranged from three months to seven years.

The analysis has brought out many interesting facts. For instance, recurrences are 6.67 per cent; in oblique hernia, 3.15 per cent; and in direct hernia, 16.61 per cent. The time of recurrence in about half was within six months, 98.6 per cent recurring within two years after operation. Therefore, it is shown that a hernia which has not recurred within two years after operation can be regarded as a cure. Recurrences in patients over 55 years of age were found so high that operation is not considered advisable unless there are strong indications.

In cases of non-descended testicle treated by the Bevan method, the testicle remained in the upper third of scrotum in 80 per cent, and remained atrophic in 55 per cent.

The vast majority of hernias recur in their original type, that is, direct as direct and oblique as oblique. A direct recurrence after an oblique operation usually indicates oversight of a saddle-bag sac at the primary operation.

Hysterectomy. Dr. F. M. Hawks followed and analyzed 84 cases of hysterectomy to determine: (1) what benefit was derived from leaving the ovaries, and (2) what harm resulted from leaving them. He demonstrated that: (1) the onset of vasomotor disturbances was delayed and the severity of the symptoms diminished by leaving one or preferably both ovaries; (2) very little harm was caused by a retained ovary (one cyst required secondary operation; one patient

experienced persistent pain referable to the retained ovary); (3) there was more trouble when the tube was removed than when it was left with the ovary. A number of similar analyses have been made.

Science of medicine. That these studies are not laboratory or experimental in nature have removed them from the attractive realm occupied by pure research, but such information and study estimated in the uplift of surgery might be fairly balanced with most of the results which reward the time-consuming efforts of the average research worker and should be subordinate only to epoch-making additions to scientific knowledge. But for such work materially to affect surgery as a whole it will be necessary to weld together the findings in many institutions, thus obtaining figures of convincing magnitude, and likewise to compare results of various institutions, some of which will afford standards to be striven for by all. To attain this ideal, the general adoption of a follow-up system is essential and likewise a somewhat uniform method for recording the results so that those of various services can be readily balanced or co-ordinated.

To summarize: The surgeon becomes more proficient; as surgery improves, the community is benefited by curtailment of economic waste; the institution profits in respect to turn-over; patients present and prospective, for whom on last analysis all efforts are directed, profit greatly.

THE SYSTEM EMPLOYED

The necessary factors are: One clerk for an average service of about 100 beds; card system; social service; follow-up clinic; collocation and analysis of mass results by special workers.

In regard to the clerk the only feature to emphasize is that the volunteer worker is inappropriate and salary is therefore necessary. The social service department is an essential part of every hospital and either exists or should at once be installed in every institution. Its follow-up work is a detail, not the reason for its existence. It is used to pursue such cases as resist summons by card. In 1921, after seven years' experience with the follow-up work we followed 95.7 per cent of all post-operative cases. Seventy-seven and seven-tenths per cent reported in person; in 20 per cent of the total the social service was called upon for help. They obtained information concerning 88 per cent of those referred to them. The card system is of necessity complicated but is quickly mastered by the clerk. Various systems have been published and need not be reviewed. They do not differ in essentials.

The follow-up clinic is the most essential feature but is likewise the stumbling block. We find a weekly Sunday morning clinic best, since the working classes are free and prefer to come then instead of at night after a day's work. The staff alternate so that no attending is on duty two successive Sundays. Two of the attending staff, three of the house staff, and one nurse serve each Sunday from 10 to 12. Regular attendance with enthusiasm and kindness in the work is the difficult factor to perpetuate week after week, year after year. It is this feature which has resulted in the breakdown of such systems as have failed.

The grouping and analysis of results should be carried out by the allotment of subjects to men on the staff and outside workers who are interested in special subjects. A system by which summaries of all important types of cases may be kept up-to-date is not difficult to carry out, and such analyses should be published.

To summarize, the advantages of end-result analyses are overwhelming and incontrovertible; the expense insignificant; the labor considerable but worth while. The factors which have militated against the general adoption and continuance of such an obviously good system are the frailty of human endeavor, often called staying power, and the lack of anything individual and effulgent in the results. For the system demands team play, not individualism, and depressing failures and disappointments rather than adulation and successes are the outstanding and yet useful elements in the analyses of the follow-up clinic.

Dr. E. A. Codman: Seven years ago the Clinical Congress of Surgeons met here in Boston. At that time the Committee on Hospital Standardization presented a report recommending a classification of hospitals into two divisions: (1) those which make an effort to find out what kind of results they are getting, and (2) those which do not. During these seven years the American College of Surgeons has made great efforts and spent many thousands of dollars on a far more complicated plan.

It is an unpopular task to criticize this movement of so-called standardization of hospitals now that everybody is doing it, just as it was an unpopular task to cry aloud to have it done. With all that we have heard and read about hospital standardization, could we today really make a preliminary classification into those which analyze their results and those which do not? Are there not still marble halls in the approved list of the College where the individual patient is only

"material," and in which analysis of the results is ignored?

Unquestionably this standardization program has helped many a hospital to raise money for laboratories and equipment. It can be made to appeal to the bankers and idle-rich of any community. The ideas expressed in the minimum standard appeal to practical common sense and reach the lay audience; undoubtedly money has been raised thereby. But has the essential idea of analyzing the end-results *in order to improve on them* been lost sight of? If today we went back to the suggestion of seven years ago and classified hospitals into those which care to follow up and analyze their end-results and those which do not, I fear we should find a much smaller approved list than we now have.

Real analysis of end-results means too much hospital "shake-up" to be taken too seriously. "All is not gold that glitters." The successful practitioner of medicine or surgery is still an accomplished diplomat and it is such men who still control the policies of most hospitals. The public benefactor is not yet ready to listen to the efficient, studious analyzer of results, but has the greatest respect for the cheerful and wise practitioner whose good common sense "saved" his baby "from having pneumonia," or who kept his neurasthenic wife from knowing the baby had pneumonia until after all danger was over.

After all, for whose interest is it to analyze end-results? Of course, the patient, medical science, and that abstract entity "the hospital" would all benefit. But no one can deny that the staff would earn less, would work harder, and would feel themselves bridled and harnessed with the trustees holding the reins. So, too, in the case of the trustees there would be more trouble. They would be obliged to hold the reins gently but firmly, on these newly harnessed horses. It would be far easier for them to leave the horses to feed themselves out in pasture as at present. They might employ a first-class hospital superintendent as coachman who would make the horses comfortable and contented and ready to prance when he cracked the whip; but even then it would be more trouble for the trustees, for they would have to watch the coachman as well as the horses. And as for the coachman, where is the ambitious hospital superintendent who wishes to drive a staff and be responsible for keeping them well groomed and contented! Most hospital superintendents rather have the animals out in pasture.

So, though it appears certain that the patients, medical science, and each hospital would be benefited by an end-result analysis of all cases, it is also true that staff, superintendent, and trustees would all be temporarily the losers.

There is a peculiar personality in a hospital called, "They"; "They" ought to do this and "They" ought to do that. It is this "They" who ought to analyze the end-results. "They" should discharge the incompetent; "They" should promote the efficient. In your hospital who is "They"? In most hospitals, I fancy "They" are utterly intangible and are usually friends of the trustees who hold positions on the staff, and who work confidentially with influential members of the trustees, rather than through the regular channels of staff meetings. "They" as a rule do not wish for searching end-result analyses. One seldom wishes for a thunderstorm for it may strike near home, and yet, if it is inevitable, we take it calmly enough.

The end-result system is something like a thunderstorm. It is an unwished-for hospital guest. It is blown on us by the winds of progress and is inevitable. Let us accept it, since we have to, with the best grace we can. Even if we in this generation treat it as evasively as we do prohibition, let us accept it for the next generation; but let us make it a staff policy and not make it necessary for the trustees to drive or to hire a coachman. Let us take the joy of the fire-engine horses to have the harness on our backs and "run with the old machine."

FUNDAMENTAL PRINCIPLES INTERPRETED FROM THE HOSPITAL STANDARDIZATION PROGRAM

BY MALCOLM T. MACEACHERN, M.D., VANCOUVER
Associate Director for Canadian Activities

I AM going to summarize with lantern slides the fundamental principles and results of hospital standardization. (*Illustrated with lantern slides.*)

1. *Organization*—organization of the professional group in the hospital is effected, thus tending to stimulate better organization throughout the other groups working therein.

2. *Ethics*—a higher type of ethics among the professional group is developed which reacts beneficially, not only on the internes and nursing staff, but also on the patient and fellow members

of the profession by an inherent desire and habit to practice medicine honestly.

3. *Self-government*—a system of self-government is established among the professional group which today is recognized as a type fruitful of best results.

4. *Efficiency*—efficiency in all professional work carried on in the hospital is demanded and this reacts in a stimulating manner on the general efficiency of the entire institution.

5. *Co-operation*—a spirit of co-operation is promoted—a fundamental principle for success throughout the hospital which primarily affects the medical group and rapidly embraces all others concerned in the welfare of the institution.

6. *Investigation*—investigation of all matters pertaining to the professional work in the hospital, whether good or bad in quality, is required so that an intelligent balance sheet of results of treatment can be obtained.

7. *Regularity*—regularity in staff procedure by meeting at regular intervals is made imperative.

8. *Helpfulness*—the fact that the program is one of helpfulness to the weaker members of the profession is always emphasized, demonstrating that it is inclusive rather than exclusive in its scope.

9. *Communalism*—a spirit of communalism is stimulated among the medical men working in the hospital and this is much needed today.

10. *Consultation*—the habit of consultation between individuals or groups of the medical profession is promoted, thus reacting beneficially, not only for the patients concerned, but for the stimulating of clinical interest and the advancement of medical science.

11. *Check-up or audit*—a careful check-up or audit of all the medical work is demanded to determine the net results of the application of medical science in the institution.

12. *Cohesion*—better cohesion is secured among the individual members of the medical profession practicing in the hospital through staff organization and staff conferences, which materially stimulate and strengthen the local, state, provincial, and national organization of medicine, all of which is so much needed today to promote health and scientific medicine, as well as to rid the country of the quack.

13. *Accuracy and thoroughness*—accuracy and thoroughness of work is demanded by careful study of the cases to make a correct diagnosis, thus applying more intelligent and competent treatment ultimately to produce the best possible results.

14. *Confirmation*—the doctor is provided with facilities for confirmation of findings through human or physical methods of investigation.

15. *Research*—a spirit of research is developed through the stimulus of clinical interest as well as the greater availability of accurate scientific data which otherwise might be passed over or not discovered if the method of procedure laid down by standardization was not carried out.

16. *Conscience*—a more profound professional conscience in the hospital is established.

17. *Hospital perspective, objective, or focusing point*—the fact that the patient must be the perspective, objective, or focusing point of all hospital services is emphasized.

By means of the monthly analysis or audit the hospital can prepare a practical, business-like summary of its results. A suggested form follows:

PHYSICAL BALANCE SHEET

Physical Report of Hospital for month of August, 1922.

(A) Volume of work:
Admitted — Died
Discharged — Remaining
Transferred

(B) Physical Assets:
Cured — Improved

(C) Physical Liabilities:
Unimproved — Infected
Complicated — Died

(D) Net Results—Physical Surplus or Deficit.

Certified correct and all details thereof duly investigated by the Medical Staff of the Hospital, this...day of....., 192..

(Signed)_____
Chairman of Staff.

(Signed)_____
Secretary of Staff.

To summarize, this standardization campaign has amply demonstrated a definite economic saving in addition to the well recognized improvement in professional care. This may be expressed in the following manner:

Net Physical Results of Hospital Standardization

1. Lessened days' stay of patients in hospitals;
2. Elimination of incompetent and unnecessary surgery;
3. Reduced number of complications and infections;
4. Lower hospital death rate.

AFTERNOON SESSION—ROUND TABLE CONFERENCE

CONDUCTED BY MALCOLM T. MACEACHERN, M.D., C.M., VANCOUVER
Associate Director for Canadian Activities

SECTION A—STAFF ORGANIZATION

BY FRANK D. JENNINGS, M.D., BROOKLYN

THE topics for discussion under staff organization are divided into six questions. I will take up these questions separately:

1. Because of the different varieties of hospitals and because of the number of doctors attending, in certain instances difficulties often arise in the selecting of the exact type of staff organization best suited to local needs and conditions. Are there any guiding principles that would help in this matter?

Taking hospital conditions on the average throughout the country, there are three types of hospitals: the closed, restricted, and open types. The closed hospital is generally a well organized institution, and may be dismissed this afternoon with just that reference. We will best serve the interests of this discussion by thinking of hospitals with either "restricted" or "open" staffs. In the East I think the restricted hospital is more common than the open and the converse is true in the Middle West and the far West.

Now, the restricted hospital, which is the type of hospital that I am connected with in Brooklyn, is administered somewhat in this fashion and I believe that if I recount to you that method of organization it will simplify the discussion.

There is, first of all, a board of trustees, lay and ecclesiastic, under which is a medical board composed of the attending staff members in the various services. The medical board is charged with a fixed and definite responsibility for the medical and surgical care of the patients entering the hospital. All the details, all the other subdivisions of the hospital, function under the medical board, the interne staff, the nursing staff, the dispensary staff, and the courtesy staff. The courtesy staff is composed of men to whom are extended the privilege of caring for private patients in the hospital, and the character of the courtesy staff frequently, too frequently, determines the standards and standing of the hospital. The men of our courtesy staff are appointed after recommendation by two members of the medical board, and after approval by the whole board they are nominated by the board of managers. The appointments are for one year. This is a simple but efficient organization.

The board of trustees says to the medical board, "Take care of the medical and surgical affairs of this institution and account to us."

Now, an open hospital is perhaps different, but the underlying principle is just the same because it simply means organization. It means getting those men who compose the professional staff of that hospital together in an organization, which need not be complicated, the simpler the better, with a constitution and by-laws.

2. One of the ultimate objects of hospital standardization is to promote a more constructive professional interest in the hospital by the doctors attending. To this end is it advisable to make more or less division of professional responsibility by dividing the staff into representative committees to look after various phases of the work, as for instance: medical committee, surgical committee, laboratory committee, records committee, etc.?

An efficient organization cannot operate successfully in any other way. A chamber of commerce, a rotary club, a large banking institution, or any large mercantile organization will function that way, and we do not differ in any sense. We are charged with the solemn responsibility of caring for sick people. That necessitates organization and it means as good an organization as we can construct. Referring again to my own hospital and the experience that we have had there, I may say that we have found that we need an executive committee. It is obvious that there must be some committee representing the medical board between meetings. It consists of the president and secretary of the medical board and one member-elect.

Secondly, the most important, is an efficiency committee. Only within the last year have we reorganized our system of distribution of work through committees.

Medical groups do not differ essentially from other groups. Some men will work, some will not. We had a committee on internes, committee on laboratory, committee on operating room, and so on. The chairmen used to work but the other members of the committees did not. It occurred to us that it would be very much more sensible to

combine in one committee all the functions that had been distributed in a large number of committees; so we appointed an efficiency committee composed of a chairman and four members. To one man is assigned internes, another the nurse training school, another the laboratories, including the diet kitchen, and another the operating rooms. The chairman exercises general supervision, presides at committee meetings, and correlates the work of the committee.

This committee has functioned beautifully. It has simplified the work because, assuming that committees are composed of three or four, we can get five men in a hospital group who will be active, efficient, and interested, where we cannot get fifteen or twenty. Now you will notice that this combines what I may term the intramural activities of the hospital. The dispensary committee is a separate committee and properly so, as its work is extramural. The efficiency committee does not include one extramural phase. The staff conference committee, because its work is so important and essential, combining as it does the necessity for arranging the monthly program for staff meetings and in addition the supervision and care of the records throughout the hospital, was made a separate committee.

3. Many hospitals, and especially those without a medical superintendent, are at a loss to know how to initiate staff organization and staff conferences. How best can these be initiated?

The way to initiate is to *initiate*. What advice can be laid down that will supply the professional staff the stimulus to do this thing if that professional staff lacks the interest, lacks the determination, lacks the will to do it? That is what counts. If your staff is right you do not have to initiate organization because the staff will do it and the staff will see the inherent necessity and inherent good. Suppose the French at Verdun had said, "We hope they will not pass." What might have happened? What did they say? They said, "They shall not pass." There was a concrete illustration of national determination of a thing that had to be done. And in a small matter it is the same.

4. The staff conference to be a success must have certain agenda on its program and definite lines of procedure. What, therefore, is the best type of agenda and method of procedure for such a conference so as to obtain the best results?

This is a broad question, difficult to answer, but taking the average hospital conditions throughout the country, in perfecting your staff organization perhaps the first thing you should do is to make the records better. That was our situation; our records were very bad; we found at the beginning that the type of conference devoted to mortality discussion was the most practicable, the most satisfactory, the most stimulating, and in the end the best, for it not alone created a condition whereby a man had to face his mortality but it made him more careful of his record. It has been of remarkable interest through these years to see the records come from conditions of absolute oblivion up to a fair degree of perfection. So that in the average general hospital at the beginning the mortality type of conference is the best.

Going on from that you come to the time when it begins to lose its interest. The records have come up nearly to par and your staff review analysis at the end of each month may not show more than fifteen or sixteen incomplete records in a month as against eighty or one hundred before. Then, perhaps, comes the consideration of morbidity and, in the last analysis, the staff review. So that I should say that the agenda should consist of, first, the staff monthly review; second, mortality; third, morbidity, and then the staff analysis or study of the staff work in that hospital. Not what somebody is doing in Vienna, not what somebody is doing in other cities, but your own staff review of its own work. That is the best.

5. Many staff conferences in hospitals today are poorly attended, evidently due to lack of interest and enthusiasm. What are some of the methods being used for stimulating interest and enthusiasm in staff conferences?

A good staff conference committee and a good program is all you need. If you have the right kind of committee and right kind of chairman with initiative and energy and the right instinct, you do not have to worry about the program. They are up to the mark all the time. Staff review opens up a field as wide as medicine. Take a review of hernias, for instance. We heard something about it this morning from one of the surgeons in New York, which shows what staff review means, and it is to the credit of that hospital and that surgeon that he publicly proclaimed the results. It is healthy, helpful, and honest. Without honesty in your staff nothing else counts.

6. Hospital standardization recommends and requires an analysis of the work during the previous month or period. What should this analysis contain and who should prepare it or present it?

We believe that it should be prepared in the record room. It is our custom that it be written

on a large blackboard and it is the first order of business taken up at a staff conference. It comprises the total number of admissions, the total number of discharges, the mortality, the number of operations, both in general surgery and special branches of surgery, the number of laboratory examinations, and the number of ambulance calls; in brief, it is a statistical study of the work of that hospital for the month and the chairman usually devotes a few minutes to its consideration, which is very stimulating. The whole thing simmers down, it seems to me, to honesty of purpose and to earnestness. We heard this morning concerning the five lights of hospital standardization. Well, there is a sixth light, and that is the light that is ahead of us all the time—the goal that we are aiming at—good hospitals and good work.

DISCUSSION

Dr. Walter E. Lambert, New York: Dr. Jennings said there is first of all a board of trustees with the medical board subject entirely to the trustees' orders; that the medical board is given the authority to conduct the medical work of the hospital. What authority has the medical board in the general conduct of the hospital and are there any medical men, members of the staff, who are members of the board of trustees? That is a very serious question which we all recognize.

Dr. H. Wellington Yates, Detroit: May I ask the essayist to discuss for us the question of mortality in relation to the monthly staff review and the staff meeting? Should these matters be discussed freely before all the physicians present and should there be a free discussion and criticism of the results obtained by various staff members?

Dr. Edward W. Mulligan, Rochester, New York: We have as high as 70 per cent attendance all the time. The men in the hospital who do the best work are always in attendance. We take up the mortality every Sunday from 12 to 1 o'clock but make it short and bring in as many patients as we can. It is at the monthly meeting that we take care of the work which you are discussing here. Is this a good thing to do? Is it a better way to do it at the Sunday meeting or is the monthly meeting better? Are we doing something that the rest are not doing? Is this weekly meeting attended by all the members of the staff, a better thing to do than to have monthly meetings alone?

Dr. Southgate Leigh, Norfolk: Infection occurs entirely too frequently, even in the work of the best operators, and in high class hospitals. This is due to several causes, such as inattention to surgical cleanliness because of its extreme simplicity, multiplicity of operators, etc., but chiefly, I believe, to the fact that but few hospitals have the proper staff control of the operating department.

Years ago in each principal hospital there was usually one dominant figure in the surgical department, who ruled the department by force of superiority and high standing, and whose hobby was the operating room and its detailed direction and control. Today in each hospital there are several high class surgeons, all standing practically on the same footing. The management of the operating rooms, however, is suffering. What is everybody's business is nobody's. Some hospitals have already recognized the danger of the situation and have appointed in each a staff operating room committee, but rarely with the proper authority.

What is needed is this: that member of the staff who is an enthusiast on the vital subject of surgical cleanliness should be selected and put in charge of the operating department and he should be given sufficient authority to control every detail of its management. The operating room nurses and assistants should be constantly under his supervision and direction, and in a judicious manner he should make such simple rules as may be necessary for the guidance of the surgical staff.

This is an exceedingly important matter for which I would ask the earnest consideration of the College. Time permits me only to mention the principle of the plan without considering its many and weighty details.

Dr. Frank D. Jennings, Brooklyn: Answering Dr. Lambert, his question, as I understand it, involves medical representation on the board of trustees. Our medical board is not represented on the board of trustees. Our board is lay and ecclesiastic but not medical. It seems to me that under average conditions lay control gives about as satisfactory a result as any. I presume you have seen, as I have, medical politics in hospitals and other places, and while perhaps lay boards may at times go astray, my feeling is that in the end average justice is done just as well by a lay board as by a medical board or a board with medical representation. I do believe that perhaps one medical representative would be good. I know of one hospital in Brooklyn which has that type of organization and I believe it has functioned very well. We get around it in this way: our board of trustees designates one man as executive member; he is the link between the board of trustees and the medical board. He meets with the executive committee of the medical board which is composed

of three, making a small committee which functions very rapidly and avoids much lost motion.

Replying to Dr. Yates, I believe there should be a frank discussion which is the practical way in which this program works. I do not see any reason why any member of the staff who has operated on a patient who died subsequently should not stand up frankly to answer any question that any member of that staff may ask as to why he did that thing or why he did not do it. This, it seems to me, is the essence of the whole proposition. But we go further; we have a little reading stand on the platform with a light overhead so that it casts its effulgence right over him.

Answering another query, we include morbidity and I believe that it should be included. This is a review of the work of the staff. We have had very striking examples of morbidity, perhaps embarrassing to the man involved but very illuminating and helpful to us all.

In answer to Dr. Mulligan, I think they are very fortunate in his hospital in being able to have such a satisfactory attendance each week. We have thought of it because often with a conference held once a month the work of a given month, particularly between November and March, may be too extensive for one meeting and we have considered whether it would be a good proposition to meet weekly. I still feel that with the multiplicity of meetings that a medical man has to attend we would do better in many instances by adhering to the monthly meetings. In many of the larger hospitals they have departmental conferences once a week but they take into consideration only their own departmental work. But the monthly meeting goes along for the whole staff. I think there is a field for the weekly service conference and indeed a field for the conference you hold and you are fortunate in doing it so successfully.

SECTION B—CASE RECORDS

By GEORGE A. RAMSEY, M.D., and ROY C. KINGSWOOD, M.D., London, Ontario

DR. GEORGE A. RAMSEY: A hospital may be described as a public utility filling a position of need. As such, its function is to give efficient service. In that service, how do records function?

The patient has the priority of claim and has the right to expect such thoroughness as is included in an effective record. The physician fulfills a duty to himself in giving to the patient such study of the diseased condition as is outlined in a record. The public, whose institution the hospital is, has a right to feel secure that the procedure therein is thorough, painstaking, and logical, in order that conservation of life may add to the community asset.

The institution needs to know that it is discharging its full duty to the community through its staff and officers to the end that efficient service may become its tradition in perpetuity.

These are axioms and it is with their application we are concerned. Records are financial, social, and medical. With these last I propose to deal.

While mindful always of the requirements of the standards set by the American College of Surgeons, I want to warn against records kept merely as so much manuscript with no attempt at application. Likewise would I add my protest at any attempt to make the hospital fit the record, and not the record to blend with the character of the hospital.

In arriving at what might serve Victoria Hospital, London, we made an analytical examination of at least thirty sets of hospital forms and chose what seemed most applicable to a municipal hospital of 400 beds for public and private patients, comprising the whole series of types of service, selecting what seemed to meet our particular needs, discarding much and here and there contributing some little thing that appeared to warrant a trial.

There was an effort made to link in harmonious union with hospital records those documents required in dispensary and follow-up social service. We had the satisfaction afterward of seeing almost an identical system described for a hospital that compared with ours in size and service.

The requirement which guided the adoption of any form was that it should be simple in legend and complete in the outline which should guide the investigator, leaving always scope for individuality. I protest against such efforts toward standardization as would stamp out individuality. Again, in the interests of economy, time, and money, we endeavored to secure such procedure as would make every single effort at record, from admittance slip to discharge certificate, a constant working tool and a permanent document. It is easy to carry system to such a degree that it enslaves. Re-duplication may weary and discourage even the most energetic.

The end purpose of a record is a diagnosis, demanding complete, prolonged, and detailed study of the patient from physical, mental, and psychological viewpoints. In this evolution of analysis the record should always be a guide to investigation, an adding machine of daily and hourly observations to the ultimate totalization of a diagnosis of the patient, not alone of his disease; and it does not stop there. Treatment follows on the conception of the cause, course, and expected outcome of the condition and is varied to meet its changing phases. If, then, it gives proof of intelligent endeavor, it deserves to be history; and if it fails, simple honesty likewise requires a record of what has been tried and found wanting.

I wish to quote Dr. Emerson's definition of a record: "It is not our imagination or our memory of past events but a painstaking entry on imperishable human documents of what is at the same time the glory and the humility of medicine, the truth as we see it, when we see it, the facts as our faltering and unskilled senses take note of it, whether in the immediate presence of suffering humanity, or at the operating or autopsy table, while still the echo of the laboratory test is knocking at our conscience. The present is ours to record. Tomorrow it belongs to the past."

Father Moulinier very strikingly has given the following definition: "Records are facts that you find, that you filter, that you focus, and then face fearlessly."

I wish to acknowledge the pioneer work of the late Dr. J. L. Stapleton in laying the foundations of our record system in Victoria Hospital, London. This was carried on by Dr. J. R. N. Childs, and I acknowledge gratefully also the sympathetic support of trustees, staff, internes, and record clerks in making the effort possible.

We have a few slides to show the cogs in the machine of our system of records following which Dr. Kingswood will demonstrate their workings.

Dr. Roy C. Kingswood (remarks illustrated by stereopticon slides): Dr. Ramsey has given you the machinery necessary for a carefully designed hospital record system. We shall now attempt to show how easily this machinery works at Victoria Hospital, London, Canada, after it has been carefully oiled and lubricated. Even the minor manufacturing concerns have men in their employ to whom they pay substantial salaries, who do nothing else but check and record the materials, cost results, and other data concerning their manufactured product. If business men deem it necessary to exercise so much care in the record of the process of manufacture of their article, how much more careful should be the medical men who are attempting to repair the human body so that a definite record should be kept of the attempt at repair while in the repair shop, namely, the hospital. Also how essential it is to the patient that a repair record should be kept for any necessary future reference. We thought our method would be best explained if we were to take an actual case and follow it through the hospital from the time of admission until discharge.

Slide 1. Mr. John Doe enters the hospital on July 1. The necessary notification has been given to the attending physician and interne. The interne visits the patient, not with a huge pad of record papers in one hand and a fountain pen in the other, but purely to meet the patient and become acquainted with him, make sure that his wants are being supplied and to find out the nature of his case. This gives the interne his approach to the patient and then a short while later he is able to obtain a history which is a real record of the patient's condition. The history embodies, first, the present complaints, second, the onset and course, and third, the previous illnesses and family history.

Slide 2.—Physical examination. The interne then proceeds to the physical examination which we require to be complete and if there are any findings in his examination which are not absolutely clear we require that he consult one of the senior men. Perhaps the two most important notations on this form are: first, the working diagnosis (after physical examination). We require that the interne write down his provisional diagnosis after he has summed up the case and that he adhere to this diagnosis until someone who knows more about the case proves that he is wrong. In this way he gets his training and is encouraged to think. Second, the signature of the staff physician. This proves to the interne that the visiting physician has been sufficiently interested in his work to read what he has written.

Slide 3.—Progress notes. This is a record of the patient's general condition, post-operative course, and condition of the wound and includes the opinion of any doctor who may have been called in consultation. We require that these be written at least every three days.

Slide 4.—Operative record. This is a concise, detailed record of the procedure and findings at the time of operation. Dictation is carefully given by the surgeon or senior assisting interne immediately after the operation.

Slide 5.—X-ray report. A report from the department of roentgenology would also be found on

the chart. A miniature reprint of the plate accompanies each report.

Slide 6. —Laboratory findings. The laboratory findings are recorded as seen and include urinalysis, blood, serological, and other reports. The interne is responsible for much of the laboratory technique.

Slide 7.—Temperature chart. The patient's temperature, pulse, and respirations are kept as above; also a record of the number of stools, urinations, and other similar data.

Slide 8.—Nurse's record. A record made by the nurse of the patient's general condition, medication, treatment, and doctor's visits, and other associated notations.

Too much cannot be said for the nurse who carefully records the condition of the patient, as she sees the patient oftener than the doctor.

Slide 9.—Dental record. To make our record complete we have a post-operative record of dental examination and any extraction, prophylaxis, etc., done at the dental clinic.

Slide 10.—Chart folder. On the discharge of the patient, the interne is responsible for checking the chart to make sure that all the records are complete. It is then placed in the above envelope, properly filled in and the discharge diagnosis completed and presented at the record office for the approval and signature of the director of records.

Now just a word as to how we obtain these records.

Slide 11.—Internes on wards taking histories. The interne has tried to win the confidence of the patient by his gentlemanly and professional approach.

Slide 12.—Internes making physical examination. We require that a nurse be present at the examination of all female patients and that the patient be draped in such a manner as to insure a careful examination and yet not offend the delicacy of the patient. In this way we have no trouble with our private patients.

Slide 13.—Convenient place to write records. This plate shows a sun parlor adjacent to a ward where the internes may write their histories without being disturbed; many discussions of the various cases take place here.

Slide 14.—Record office. One corner of the record office showing an interne dictating a history just completed and the other interne giving the operating room report immediately following an operation.

Slide 15.—Group of internes on the surgical service analyzing the records of all cases of carcinoma of the breast admitted in 1921 with the idea of publishing their results. This leads to staff conference analysis and promotion of scientific research.

Slide 16.—Operating room scene. This patient had a laparotomy performed two years ago and probably just as important a factor as the proper technique of opening the abdomen is the previous operating room report to show what pathology was found at that time. The interne is reading this former report in detail.

Slide 17.—Cost of chart system. The cost of our system is 51½ cents per patient per year.

Is it not worth while from your standpoint, fellow practitioners, to know that a complete record of your patient is being kept while in the repair shop? Is it not your duty to make sure that these records are written for your patients wherever you may send them—even if you have to write them yourself? And you who may be patients in the repair shop—do you not consider for your sake that these records should be kept?

SECTION C—CLINICAL LABORATORIES

By JOHN F. BRESNAHAN, M.D., Bridgeport, Connecticut
Superintendent, Bridgeport Hospital

THE following questions have been assigned to me in the discussion of this subject:

1. In some hospitals today there are very fine laboratories capable of doing all the services necessary, but not much used by the medical staff. What methods can be employed to stimulate increased use of such laboratories by the staff?

In a great many hospitals one finds the laboratory located either in the basement or in some part of the grounds other than in the main hospital. The pathologist is present in his own little department but does not come in contact with the patients in the wards. He sometimes, but rarely, leaves the laboratory. The specimens, whether tissues or blood smears, come to him without any connection with the patient whatsoever. He has not seen the patient, and the slip sometimes merely names the part of the anatomy from which the specimen is taken but no other information is given. He gets into the habit of looking at these samples as having no connection with anything else except the container in which they come. He then tries to guard against mistake, and in order to avoid being mistaken he very often will first hedge, and then incline to give an affirmative diagnosis only in case the indications are very marked. The pathologist and roentgenologist should be consultants and when we have our pathologist coming in contact with the patient as consultant, then I think we will clear up that first question. In our hospital the pathological laboratory is a service of consultation, for example, the consultation slip goes to the pathologist, and he sees every patient from whom blood is taken and can give a better opinion on border line reactions than if he never saw the patient.

2. There are various systems used in our hospitals for making laboratory charges; some according to schedule of prices per test or examination, and others by means of a flat rate. In the opinion of many the method used in making laboratory charges has a direct relation to the laboratory service. What, therefore, is the most desirable method to adopt?

The hospital superintendent generally has to face a deficit. When the deficit is a little larger than expected (as it is every year) he has three methods of approach or three methods to solve the problem. First, he attempts to reduce the price of food, and the quality of food is apt to fall. Next, he raises the rates of private rooms; and, next, he inspects the laboratory charge to see how he can split it up and make an extra charge. So that where it used to be a two-dollar flat rate fee they now split it into three or four items of one dollar each. What happens to the patient who comes in with an obscure disease for which a number of laboratory tests are necessary? He is penalized, so to speak, for having an obscure disease, and the number of laboratory tests raises the cost for that patient, which is not right. After all it seems as though the limit for charging patients has been reached. If the laboratory tests necessary for diagnosis are costly, out of proportion to what the patient pays, instead of trying to get the patient to pay more we should go out for a definite campaign either to endow that laboratory or to collect money for the purpose.

In too many hospitals the laboratory charge is gradually increasing. A doctor says: "I would like to order a fluoroscopic examination, but the patient cannot afford to pay for it." Or, "I would like to have that tissue sent away to a reliable laboratory and have it checked up. It does not look like carcinoma, and I would like to be sure of it." But a little extra charge of ten dollars determines the matter in the mind of the doctor as to whether that patient shall have a laboratory examination.

One of the best ways to do it is to have a low flat rate for each patient, say two dollars, and let that include everything and if the laboratory is not self-supporting let us make it so and not ask the patient to pay more.

3. There appears to be no definite information as to the extent to which routine laboratory examinations should be carried out. What is the general opinion in regard to this?

I do not think anybody can answer that question except the staff of the particular hospital involved. It may be a wise thing in some communities to have a routine Wassermann examination of all ward patients and it may be necessary sometimes to make exceptions to that rule but it works out in most cases. I do not think that question is answerable except in particular hospitals where the staff can meet and adopt a routine

procedure which fits that community. But there is one routine procedure which can be adopted to advantage and that is in the maternity department; when a woman is delivered and the cord is cut, a test tube is held under the cord and part of the blood allowed to run into it. This blood is sent to the laboratory and thus one is able to detect specific disease and start treatment immediately for both the mother and child.

There ought to be no question that a hospital should require at least a urinalysis, hæmoglobin determination, and leucocyte count. To my mind there is no question, in fact, it is absolutely essential that every piece of tissue removed in the operating room should be sent to the laboratory for examination. This examination, at the minimum, should consist of the gross pathology, and a report of the microscopic examination.

4. Many small hospitals today have considerable struggle carrying on a laboratory service for their institution, especially when there is no highly trained pathologist or bacteriologist in the community. Many also are anxious to know what facilities should be provided and the extent to which the service should be extended. Therefore, how far should the small hospital go in its laboratory service? What facilities should be afforded and what personnel?

In a small community, especially hospitals in the country, it is sometimes necessary to induce some of the younger men who have had good training, to specialize in laboratory procedure, or to go away and take a course in laboratory technique. Almost any hospital will take as an assistant a young physician who wants special training of this kind. Then he can go back to his own community and supervise what is being done in the laboratory. Specimens which may have to be sent to a city laboratory, for example, can be reported on by telegraph if necessary. If the situation will warrant it the doctor can take one of the nurses in the hospital and show her the routine necessary for simple laboratory procedures, sending specimens requiring highly technical examination to the state laboratory or to a good ethical laboratory under private auspices.

In our own hospital we have two graduate nurses who serve in the laboratory. These nurses have been taught to make the routine blood analysis and other tests. One of these nurses works one week in the laboratory and the other week alternates in taking routine histories in the wards. It works out very well. These young women can be taught the ordinary laboratory procedures and when internes are not available they will be found valuable aids to the hospital laboratory if they are checked up in their work by the pathologist of the hospital, not once a month or once a week, but every day.

SECTION D—ROENTGENOLOGICAL SERVICE

By WILLIAM A. LaFIELD, M.D., Bridgeport, Connecticut

IT has been suggested that our discussion of this subject be limited largely to the extent and supervision of X-ray service in hospitals. Accordingly, our program contains the following questions to guide our discussion:

1. Hospitals today are asking what should constitute a complete service in an X-ray department. Should all institutions be able to perform fluoroscopic examinations, gastro-intestinal work and treatment?

2. In many hospitals today the X-ray department is under the management of trained technicians. It is generally stated that interpretation of X-ray plates can only be done successfully by the trained medical man. In such places as cited, interpretation has to be left to the individual physicians referring cases. Is this satisfactory, and can you have an efficient X-ray service in this manner?

I have great reluctance in coming before you and attempting to give precise answers to some of your problems as to the X-ray laboratory in a small hospital. May I say first a word as to the responsibility of the roentgenologist. In the first place, the responsibility for the service must be left to a competent roentgenologist who must be a graduate physician well versed in anatomy and physiology; he should be a competent physician, so that he may study with you the essential data regarding his X-ray finding and give you an intelligent interpretation. He must have a fair working knowledge of radio-physics. He must be a good amateur photographer, something of an electrician, and something of a politician. The technician—the individual who does the routine work of the laboratory—should be a graduate nurse trained by a roentgenologist and should follow a definite routine technique in all roentgen examinations; and she must work under the supervision of an attending roentgenologist. She must confine her activities entirely

to X-ray practice. She must work under such supervision that she will realize her limitations and responsibilities.

With a hospital of perhaps 100 beds or in a community of 25,000 or 50,000, it is not usual to have a man giving his entire thought and attention to the practice of roentgenology as a profession. A community as small as that will not adequately support a man doing roentgenology as a specialty. In any hospital measuring up to the standard of the American College of Surgeons there is no reason why this department could not be placed under the intelligent supervision of a roentgenologist who is not necessarily an active member of the hospital staff. He may be a man in a comparatively remote place from the hospital he serves. It seems to me the first plan would be to establish a small department under the immediate supervision of a graduate nurse who has been trained in this work.

Perhaps we can best bring out the answer to the first question, "What should constitute a complete service in an X-ray department?" by giving you first the limitation of your roentgen service. There is no doubt in the mind of every man doing extensive work in this line that every hospital should be equipped to do roentgenological examinations of the gastro-intestinal tract, chest, skull, and the urinary tract. Some hospitals leave the entire charge of roentgenology to a technician. Would you rely upon the opinion of an orderly or a nurse for an interpretation of the changes in the renal pelvis? Would you rely upon the opinion of a high school graduate, not a graduate physician, as to the significance of a tuberculous lesion in an extremity? In my mind there is no question as to who should assume the responsibility of X-ray interpretation.

The interpretation of X-ray plates cannot be left to the various members of the hospital staff. The relationship of the roentgenologist to the staff is the relation of the consultant to the physician. If the roentgenological service is to be of any real value in your hospital you must look upon your roentgenologist as a consultant. If the roentgenologist is of the right type his opinion is just as valuable as the opinion of your attending neurologist. In our hospital we do not send a requisition for an X-ray examination; a consultation is arranged and the patient is referred to the X-ray department for consultation. If a medical roentgenologist is in charge of the X-ray department he should be equipped to do roentgen therapy. That is a procedure of such responsibility that it cannot be left to a technician no matter how well trained.

I am in a position to judge somewhat of the X-ray needs of a hospital in a small community, and I believe we have solved the problem for one hospital in our state near Bridgeport. A hospital of about 100 beds in a community of 25,000 has a competent graduate nurse in charge of the roentgenological service and the films that are taken there are sent to us for interpretation. A roentgenologist can in the course of two or three months train a graduate nurse in the roentgen examination of the gastro-intestinal tract so that she can produce a series of plates following out a standard technique. A movement has now been instituted by the American Roentgenological Society to standardize X-ray reports. A long time ago routine examinations were standardized as to technique, and the standardization of the report and the individual interpretation of it will mean adequate service for the small hospital.

I believe that technicians assuming the responsibility in hospital X-ray service should be examined as to their fitness for the work, be registered, kept within their limitations.

SECTION E—NURSING SERVICE

By Miss MARY BEARD, Boston
Superintendent, Instructive District Visiting Nurses Association

THE report which I will present is a summary of the nursing survey made by the Rockefeller Foundation and includes the nine conclusions to which the committee came.

This study of nursing education originated in January, 1919, when, due to the fact that the Rockefeller Foundation had been appealed to from so many angles to give gifts to support nursing education in one way or another, it decided that it was advisable and really would help the cause to get together about fifty persons concerned in education and discuss the advisability of making a really thorough scientific study of the whole subject of public health nursing, particularly whether anyone other than a graduate nurse could do this work effectively, and if so what preparation that other woman ought to have. It was the pressing need for more nurses in the field of public health that first suggested the desirability of such an investigation.

The committee states that they have attempted to survey the entire field occupied by the nurse and other related workers of this type, to form a test of the qualifications necessary for their education, and on what basis such a function would be sound economically and conform to educational standards, for which there appears to be a vital social need. The persons constituting the committee as it finally got to work—because almost immediately when we began to study the subject of public health nursing we found it necessary to study the subject of nurses—consisted of doctors and hospital superintendents, the latter including nurses and physicians.

The nine conclusions to which the committee came, it seemed to me, you would want to hear, because they take up the really important and controversial points in the question of education. The conclusions are as follows:

"1. That, since constructive health work and health teaching in families is best done by persons (*a*) capable of giving general health instruction, as distinguished from instruction in any one specialty; and (*b*) capable of rendering bedside care at need; the agent responsible for such constructive health work and health teaching in families should have completed the nurses' training. Experts other than nurses, such as nutrition workers, social workers, occupational therapists, etc., should be called on to perform their special functions, in cooperation with the nurse.

"That as soon as may be practicable all agencies, public or private, employing public health nurses, should require as a prerequisite for employment the basic hospital training, followed by a post-graduate course, including both class work and field work, in public health nursing.

"2. That the career open to young women of high capacity, in public health nursing or in hospital supervision and nursing education, is one of the most attractive fields now open, in its promise of professional success and of rewarding public service; and that every effort should be made to attract such young women into this field.

"3. That for the care of persons suffering from serious and acute disease the safety of the patient, and the responsibility of the medical and nursing professions, demand the maintenance of the standards of educational attainment now generally accepted by the best sentiment of both professions and embodied in the legislation of the more progressive states; and that any attempt to lower these standards would be fraught with real danger to the public.

"4. That steps should be taken through state legislation for the definition and licensure of a subsidiary grade of nursing service, the subsidiary type of worker to serve under practicing physicians in the care of mild, chronic, and convalescent illness and possibly to assist under the direction of the trained nurse in certain phases of hospital and visiting nursing.

"5. That, while training schools for nurses have made remarkable progress, and while the best schools of today in many respects reach a high level of educational attainment, the average hospital training school is not organized on such a basis as to conform to the standards accepted in other educational fields; that the instruction in such schools is frequently casual and uncorrelated; that the educational needs and the health and strength of students is frequently sacrificed to practical hospital exigencies; that such shortcomings are primarily due to the lack of independent endow-

ments for nursing education; that existing educational facilities are on the whole inadequate for the preparation of the high grade of nurses required for the care of serious illness and for service in the fields of public health and nursing education; and that the chief reason for the lack of sufficient recruits, of a high type, to meet such needs lies precisely in the fact that the average hospital training school does not offer a sufficiently attractive avenue of entrance to this field.

"6. That, with the necessary financial support, and under a separate board or training school committee, organized primarily for educational purposes, it is possible with completion of a high school course or its equivalent as a prerequisite, to reduce the fundamental period of hospital training to twenty-eight months and at the same time, by eliminating non-educational routine and organizing the course along the intensive and co-ordinated lines laid down in Miss Goldmark's report, to give a sound and practical training, entirely adequate for the preparation of the type of nurse needed for the care of the acutely ill and for the hygienic education of the public; and that courses of this standard would be reasonably certain to attract students in increasing numbers and of high quality."

That is, in twenty-four months with four months added for preliminary training, if we followed Miss Josephine Goldmark's outline of study and made these twenty-eight months really educational, we should provide a graduate nurse who really would have had experience in mental illness, in communicable disease, in pediatrics, and in nutritional study. It was found in one of the very best hospital training schools that we have in this country, that a process went on which was known as milking the floor of the diet kitchen. That was actually a process of rubbing that floor with milk and it took half an hour a day of the nurse's time, the nurse who was fitted to care for the sick. The milk had a tendency to polish the floor, the custom was established many years ago when the milk supply was plentiful, and few people knew that it was being done!

A Vassar training camp student sent to one of these hospitals to complete her training, was made to do that thing. But she did wish she had more opportunity to find out about the care of sick people. And in another hospital, a registered hospital too, the single lecture which the nurses were to have in nutrition was attended by the investigator, and it was found that it was being given by a man who was an advertising agent for a food preparation. He had asked for the privilege of talking to these girls in training about foods and this was the only lecture they had on nutrition. Those instances you will find in Miss Goldmark's report.

In following her recommendations it will be found that the twenty-four months, with four months extra for preliminary training, are to be given to the study of those things which theoretically we have, but actually and practically too often we do not have.

"7. That the development and strengthening of University Schools of Nursing of a high grade is likely, directly and indirectly, to accomplish more for the improvement of nursing education than any other single step which can be taken at the present time.

"8. That when the licensure of a subsidiary grade of nursing service is provided for, the establishment of training courses in preparation for such service is highly desirable; that such courses should be conducted in special hospitals, in small general hospitals or in separate sections of hospitals where nurses are also trained; and that the course should be of eight or nine months' duration.

"9. That the development of nursing service adequate for the care of the sick and for the conduct of the modern public health campaign demands as an absolute prerequisite the securing of funds for the endowment of nursing education of all types; that it is of primary importance, in this connection, to provide reasonably generous endowments for University Schools of Nursing; and that gifts for this purpose, at the present time, are likely to accomplish greater results in the promotion of the health of the people than those which are offered by any other line of community or philanthropic effort."

DISCUSSION

Mrs. William Lowell Putnam, Boston, Massachusetts: I have been for many years interested in the training of nurses spoken of in the fourth section of the conclusions. I believe, speaking as one of the public, that the nursing needs of the public are not now being taken care of adequately. The very poor and the very rich are cared for but not the large body of people. If they employ a trained nurse the price is now absolutely beyond their means and they descend to the ranks of the poor. For those people, nurses can be provided of a separate grade and I should be very glad—in fact I will ask any of you who will attend the school for which I speak—to welcome you at the Household Nursing Associa-

tion at 222 Newbury Street. We have for a great many years carried on this work and the attendants whom we graduate have been found entirely satisfactory to everyone employing them. They are given the four months' bedside training in the hospital and two months' training in dietetics, including housework because they supply the need of the sick. They do the housework and care not only for the sick in the home but for the home in the sickness, which is very often what a tired and sick mother wants—to avoid getting up to cook an early breakfast and send the children to school, to find these things taken from her, and to see that the children are sent along to school and the husband with his dinner pail.

We work with a very high grade hospital for our training. In the September report for the summer months, there were fifteen of our students trained at the Memorial Hospital in Gardner, three in the Framingham Hospital, thirteen in other hospitals, and fourteen taking training at their home. The price, of course, is very much less and for chronic cases and cases of mild illness, they are absolutely satisfactory. Take, for example, a maternity case, where the woman is delivered in a hospital. She does not require a trained nurse to take home with her to take care of her baby. The trained nurses are not now taught to do many of the necessities of life for the patient of moderate means. They do not like to wash the baby's diapers, or carry up the breakfast tray. And those things are not a part of the trained nurse's training, and it seems to me, if you will excuse me for saying so, that the fault lies with the medical profession. The medical profession undertake, to their glory, to take care of all classes of people, no matter what their means, and there is nobody in the community who does so much for charity. But they have not socialized the training of nurses as they should.

I was consulted the other day by the State Nurses Association, who wanted to bring in a bill to have a supervisor standardize the training of nurses. They do not want a doctor, they want a nurse. Now the nurse and the social worker are the doctor's right hand, and we are taught on high authority: "Let not your right hand know what your left hand doeth." But there is nothing to prevent letting your brain know what both hands doeth.

THE RIGHT OF A HOSPITAL TO APPOINT A STAFF

By A. R. WARNER, M.D., Chicago
Executive Secretary, American Hospital Association

THREE factors have caused the current keen and general interest in the question of the right of a hospital to appoint a staff. The inquiry comes from every group interested in hospital work.

1. The rapid increase in the number of hospitals appointing a medical staff. The motives behind the appointment of staffs have been primarily to insure the patients of the institution—particularly the free and part-pay cases—a better medical service. It is done secondarily to secure the continuity and the unity of professional policies necessary to develop teaching and also to create an organization which can properly direct and develop the various aids to the professional work maintained by the hospital (as laboratories, etc.). The arguments advanced and points considered have been confined entirely to the internal operation of the institution. The right and duty of the hospital to do this have not been emphasized and established and are, therefore, questioned by objectors.

2. The organization of those objecting to the existence of the hospital staff, and concerted action by these objectors. Several state legislatures have passed bills removing from the classification as charitable institutions (tax free) any hospital not admitting to practice in the institution all licensed practitioners of the state. This included not only the regular graduates in medicine but the medical cults as well. The cults have vigorously protested because the existence of a staff and professional policies and standards in hospitals have kept them out. These bills were all vetoed by the Governors but considerable publicity on the question was secured. Objectors in the regular medical profession have been active. One county medical society of Ohio promptly expelled eight of its members who accepted positions on the newly formed staff of the local hospital.

All objectors have questioned the right of the hospital to choose its agents or, as they have expressed it, "to discriminate."

3. The clearer establishment of a definite liability of the hospital for its patients. The word "liability" has an ominous sound: it suggests litigation and damages. Hospitals know that their liability has increased and that supreme courts

are confirming damage awards in some cases. Instead of studying their liability and developing plans to meet it, the hospitals generally have shuddered at the very thought, hoping that such a calamity might never come to them and have feared even more the suggestion of a lawsuit. The reaction of the hospital in this frame of mind to the threat of a local practitioner to sue "for his rights" and "for damages if excluded from the institution" is often so feeble and timid as to be pathetic. Sometimes this is not purely bluff on the part of the local practitioner. He really believes that the funds to build and maintain the hospital were given, primarily, to provide facilities to physicians for their personal use and, secondarily, for the welfare of the patients, instead of, primarily, for the welfare of the patients and, secondarily, to the profession as a whole for its development. Every hospital must know the basis of its appeal for funds—whether for the physicians in the community or for the patients in the institution—and the trust assumed in accepting funds, to carry out this purpose is the only obligation. In this they are fully protected and it is the failure to perform this trust to the letter that creates the liability.

These three factors have not only raised the question as to the right of the hospital to appoint the staff but surrounded it with many complications, irrelevant to be sure, but nevertheless confusing. These can be neglected. By "right" is meant legal right. The question as to the advisability of the staff is not a factor other than indirectly through the establishment of the decision that a staff does or does not better the service rendered to the patients in the hospital. The courts would certainly recognize not only the privilege but the obligation upon the trustees of every hospital to provide every reasonable means in their power to improve the professional service rendered by the institution to its patients. This is the trust they have assumed. But all this depends on the interpretation of the value of the staff to the patients. This is not final—therefore not considered here. The final answer to the question is, of course, to be found in the law itself as finally interpreted by the Supreme Court. Let us consider this.

In the decisions of all courts on questions pertaining to the liability of hospitals, two fundamental principles have always appeared. In a way, these principles are irreconcilable. The first principle invariably considered is the protection of the rights of the individual. There never was any question as to the liability to a person injured by a nuisance created by the hospital on its premises and the question always arises as to why patients should be excepted. The second principle invariably considered is the obligation upon the courts to protect trust funds and to preserve them for the purposes designated by the donor. All hospital funds are trust funds and given substantially for the same purpose, which is for the maintenance of indigent patients in the institution. Dissipation of these funds by the awarding of damages certainly is not protection.

The conflict between these principles has produced in the past a great variation in the court decisions. Every decision has been an attempt to reconcile these two principles. We can omit here all discussion of the many decisions that have contributed to the development of a policy or tendency of the courts to unite on a definite position as a just compromise between these two principles. It is an interesting story but long. The fact only needs to be presented.

A recent decision of the Ohio Supreme Court (No. 16926—Decided January 24, 1922) sets forth this compromise clearer than others have done and states more concisely the guiding principle under which the decision (a unanimous one) was reached. It reads as follows:

"Where a public charitable hospital has failed to exercise due and reasonable care in the selection of physicians, nurses, or attendants and injury results from the incompetence or negligence of such persons, the hospital is liable."

In the development of this compromise came the recognition that trustees are obligated to make every reasonable effort to carry out the provisions of a trust, but no more. The trustees of the hospital and no others are the responsible trustees of funds given to the hospital in trust. A board of trustees cannot and is not competent to supervise every act of every agent of the hospital, but it can "exercise due and reasonable care" in the selection of all agents. To do less than this is to be false to the trust.

Such argument led to the present tendency of the courts to limit the liability of the hospital to the requirement that the responsible trustees shall "exercise due and reasonable care" in the selection of all agents, but after this has been done to absolve the hospital from responsibility for the acts of the agents so chosen.

Conclusion and answer to the question. The responsibility "to exercise due and reasonable care in the selection of physicians, nurses, and attendants" guarantees to the trustees full freedom to make this selection and in their own way. If they choose to announce their choice through an appointment to a staff or by inclusion on a

privileged list or in any other way, they may do so. The effect is the same: They made the selection and are responsible therefor. *A hospital not only has the right to select a staff but is obligated "to exercise due and reasonable care" in the selection. The right to select carries with it the right to reject and for any reason their judgment may dictate.* The trustees carry all the responsibility.

Some who would recognize the right to appoint a staff would question the right of the hospital to refuse a licensed practitioner the privilege to treat a private patient in the institution. All court decisions known to the writer have brushed aside questions as to payments made or the status of the patient in the hospital. All patients in the hospital are pointedly classed alike. It is undoubtedly true that a hotel would find it difficult to exclude any licensed practitioner of medicine from treating any guest of the hotel. It is also likely that a hospital could not legally prevent a licensed practitioner from merely visiting and advising a patient, if this was desired by the patient. Such a situation, if objectionable, necessarily must be handled by the exclusion of the patient rather than the exclusion of the doctor.

But if the hospital grants to any physician the right to direct the work of any employee or attendant of the hospital, it clearly accepts this physician as its agent and is as responsible for him as for a full staff member. As it is quite impossible for a physician to treat a patient in a modern hospital without directing the work of nurses and other attendants of the hospital, the trustees necessarily assume full responsibility "to exercise due and reasonable care" in the selection of this agent when this privilege is granted. Again the responsibility to select carries with it the right to reject.

WORK OF THE HOSPITAL SURVEYOR

By E. MURRAY BLAIR, M.D., Vancouver
Hospital Standardization Department, American College of Surgeons

IT seems to me the best method of approaching this subject is for you to go with me on an imaginary hospital visit, call on a hospital, and examine the points which we consider essential in arriving at a conclusion.

At our arrival we find that we are not unexpected and I want to bring out this point at the very beginning. It shows the attitude of the College visitor toward the hospitals; he invariably requests an interview by telephone. The College visitor does not telephone to the hospital and say, "I am coming"; there is no idea of dictation in any of our work at any time; it is suggestion from start to finish. We are there for your own good, we hope, and our suggestions are offered in good faith. If they are of value we want you to receive them; if they are of no value they are automatically dropped.

We ask for the minutes of the staff meetings from which we can glean a great deal. We ascertain the regularity of the meetings, the type of programs held, and the analysis of end-results. We find out, also, from the minutes, or in some other way, whether the staff has gone on record prohibiting the division of fees under any guise whatever. We must look for that and be sure that it is there and lay emphasis on it if it is missing.

During our visit to the wards we examine the current records to see whether they are stereotyped histories of questions answered "yes" or "no," or whether they are really accurate stories of the complaints. We want to know if there are complete physical examinations of all patients, regular progress notes, and accurate operation records.

In looking at the charts we look for a provisional diagnosis. We believe that a provisional diagnosis is important from many standpoints. When a patient is admitted there should be something definite on record to say why he is in the hospital. Another thing about it is that it is a splendid thing for a doctor to be able to go on record, and if he is wrong to *be* wrong. Recently a prominent physician said to me, "I think the most discouraging cases I have to meet are my patients which come to autopsy." We go over on the private side and look at the records in exactly the same way because we believe there should be no difference in the records for the public and the private patients.

An extraordinary thing in hospitals is the extreme lack of laboratory work that is found. Some very able men in this land seem to forget their laboratory work for some reason. In examining the equipment we want to feel that there is at least enough for the simpler experiments and as much more as possible. We want to know about the technician, about her supervision, and about the pathologist; we want to know about the facilities for the tissue work, whether done in the

hospital, and if not, where it is sent. There is no reason why laboratories should not be utilized to a greater extent. When I have talked to technicians about it, they have said, "Certainly, we are wrong; there is more we can do and we will do it." Our hospitals are built around our laboratories; each hospital is a scientific institution because it has a laboratory. The old idea of building a hospital around an operating room has gone. It is our duty to see that our laboratories are exploited as far as possible. The record room of the laboratory, also, is important. We want to feel that it is the headquarters for scientific work. We want to feel that all the work which goes on in the laboratory including the records thereof is well done.

We ask to see the record room where we study the record system, including the alphabetical index, disease index, and filing cabinets. We inquire as to the use made of the card indexes, for there is no use asking hospitals to put in an elaborate system of indexes if they never use them.

We will take 50 records at random, say within the last two or three months, and we will study them carefully, checking the percentage of personal histories, physical examinations, working diagnoses, operation records, progress notes, laboratory findings, and condition on discharge. At the end of our examination of the charts we call the superintendent in and discuss the results, so that there will be no misunderstanding.

The College visitor finds an enormous satisfaction in this work for there is something about it which you cannot find anywhere else. Every problem is a different one. We feel that we are in a work which is worth while. Our examination is based on an economic standpoint. We know that it is a great help wherever it is put into effect and that it is a stimulus to any hospital and to its patients. It undoubtedly affords the community a better place in which to be sick.

A PACKAGE LIBRARY OF SURGICAL LITERATURE

A Loan Service Furnished Without Charge by the Library of the American College of Surgeons

THE Library and Department of Literary Research of the American College of Surgeons has undertaken the compilation of a package library, material from which will be loaned, without charge, for research work on surgical subjects. This package library is a practical means of bringing the library service of the College directly to the Fellows wherever they may be, and of serving especially those who are located far from any medical and surgical library.

The collection contains reprints and articles clipped from medical and surgical journals classified for ready reference. With the hearty cooperation of the Fellows the Department began the accumulation of this material over a year ago and contributions are still being received. The grouping and classifying, however, have been in progress for little more than four months. In this short time, loan material has gone out in connection with the research work of the Department on thirty different subjects such as: treatment of fractures, arthroplasty of all joints, fractures of the patella, megacolon, and pyelitis. In twelve instances, requests for information were answered entirely by a selection of material from the package library.

As the collection grows it will become more and more useful. When requests are received by the Department of Literary Research only a few days in advance of the surgeon's need for the material and there is little time for compiling bibliographies and abstracting articles, reference is made to the package library, material from which can be selected and mailed without delay. Only a very incomplete service can be furnished in this way, however. More often the package library material will supplement the work of abstracting and translating. A number of original articles with full description of technique, charts, and illustrations add materially to the information given in the abstracts. The selected articles are easily carried in a convenient package and will be read by the physician when he would not have the time to do the same amount of reading in a library from the bound journals.

The articles from the package library are loaned for a period of two weeks and the time is frequently extended upon request. The prompt return of the material is, of course, essential if the collection is to be maintained. This is especially true now while the collection is small considering the demands made upon it.

Every Fellow of the College is asked to furnish the Department with two copies of the reprints of his articles. One copy is placed in a collection of the works of the Fellows, and this file should be made complete and held intact as a permanent record. The other copy is placed in the loan library.

In addition to this material in the package library a number of surgeons have contributed their collections of reprints and unbound files of leading surgical journals for the clipping service. The Department is always glad to have the co-operation of the Fellows in this connection and would greatly appreciate it if any surgeon would send in a list of odd numbers or more complete files of the journals he would be willing to contribute for this purpose. The Department can then select material not already in the file and notify him of the need for a part or all of his offering.

Through this brief announcement of the package library service, the Department of Literary Research asks the continued co-operation of the Fellows to furnish articles which should be in the permanent collection and in the package library, and invites them to send in their requests for research work which can be supplied in part at least by this free loan service.

IN MEMORIAM

Stephen Smith

1823 1922

DR. STEPHEN SMITH, Honorary Fellow of the American College of Surgeons, died on Saturday, August 26, 1922, at the home of his daughter, Mrs. Walter S. Mason, Montour Falls, New York, aged 99 years, 6 months, and 8 days. He was the oldest member of the College and unquestionably the oldest American surgeon or physician, who had attained like fame and distinction in a career marked by many notable achievements. Dr. Smith was born at Spafford, Onandago Co., New York, on February 19, 1823, and graduated from the College of Physicians and Surgeons, New York City in 1851. His mother lived to be 97, and his sister, Miss Mary Smith, died at the age of 100 years and 1 month. In 1849, before his graduation he served as medical interne at the Sisters of Charity Hospital, Buffalo, New York, during an epidemic of Asiatic cholera, and contracted a mild attack of the disease himself. In 1850 he was a member of the resident staff of Bellevue Hospital, and 1854 a Visiting Surgeon to Bellevue, serving until 1864, when he was appointed surgeon to St. Vincent's Hospital, and in 1890 to the Columbus Hospital.

In the Civil War he served as Volunteer Surgeon at Fortress Monroe and Fredericksburg. Later he was a member of the committees which drew plans for the Roosevelt Hospital, New York City, and for the Johns Hopkins Hospital of Baltimore. He was a lecturer at Bellevue Hospital Medical College until 1874, when he became professor of clinical surgery in the University Medical College, New York.

He was the author of the handbook entitled *Principles and Practice of Surgery* which was supplied to every regular and volunteer surgeon at the beginning of the Civil War. This book was later published by the Southern Confederacy anonymously and was also supplied to their surgeons.

In 1851 he began his work in sanitation and was the chief author of the Sanitary Code which was adopted as a State Law in 1866. This, the first effective public health law, is perhaps the greatest monument to his memory. He was the founder of the American Public Health Association, and its first president in 1872, being subsequently re-elected three times. In 1878 he started the work of forming a National Board of Health, and in 1882 drew up a law which established a State Board of Health in New York State. In 1894 he was appointed by President Cleveland one of three United States delegates to the International Sanitary Conference at Paris.

In 1881 he was appointed one of the commissioners of the State Board of Charities and in 1892 State Commissioner in Lunacy, being reappointed several times to both offices.

On November 16, 1921, the American Public Health Association gave a remarkable banquet in his honor at the Hotel Astor, New York City. Dr. William H. Welch acted as toastmaster. Dr. Smith, then nearly 99 years old, read a paper which he had written for the occasion, on "A Half Century of Public Health," and he stood throughout the entire speech.

His death closes a career of remarkable achievement, especially in the field of Public Health. He is survived by a son, three daughters and six grandchildren.

CHARLES H. PECK.

SURGERY, GYNECOLOGY AND OBSTETRICS

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SYMPOSIUM ON CARCINOMA OF THE JAWS, TONGUE, CHEEK, AND LIPS

General Principles Involved in Operations, and Summary of Results Obtained

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II. At the Mayo Clinic: Carcinoma of the Tongue. By E. S. Judd, M.D., F.A.C.S., and Gordon B. New, M.D.

III. At the Presbyterian, Memorial, and Roosevelt Hospitals New York: Carcinoma of the Cheeks and Lips. By George E. Brewer, M.D., F.A.C.S.

Discussion by Albert J Ochsner, M.D., F.A.C.S.; Vilray Papin Blair, M.D., F.A.C.S.; Douglas Quick, M.D., George P. Muller, M.D., F.A.C.S., and Channing C. Simmons, M.D. F.A.C.S.

CARCINOMA OF THE JAWS, TONGUE, CHEEK, AND LIPS

General Principles Involved in Operations and Results Obtained at Cleveland Clinic [1]

By G. W. CRILE, M.D., F.A.C.S., Cleveland, Ohio

IN the brief time allotted to individual papers in this symposium, it is impossible even to summarize the important contributions to the literature pertaining to operations for carcinoma of the mouth which have been made by many surgeons, notably those which have proceeded from Boston, New York, Philadelphia, Rochester, Chicago, Baltimore, New Orleans, and other centers. I shall, therefore, without discussion of the points of view of others, confine myself to an enunciation of the principles based on the work in the clinics of these cities in accordance with which our surgical management of these cases is planned.

A study of the literature pertaining to cancer of the head and neck shows that among 4,500 reported autopsies, in only 1 per cent were secondary foci found in distant organs or tissues. That is, when death results from a cancer of the head or neck, it is because of local and regional development of the disease, not by distant invasion. The collar of lymphatics about the neck forms an almost impassable barrier through which cancer rarely penetrates; and every portion

[1] Presented before the Clinical Congress of American College of Surgeons, Boston, October 9–13, 1922.

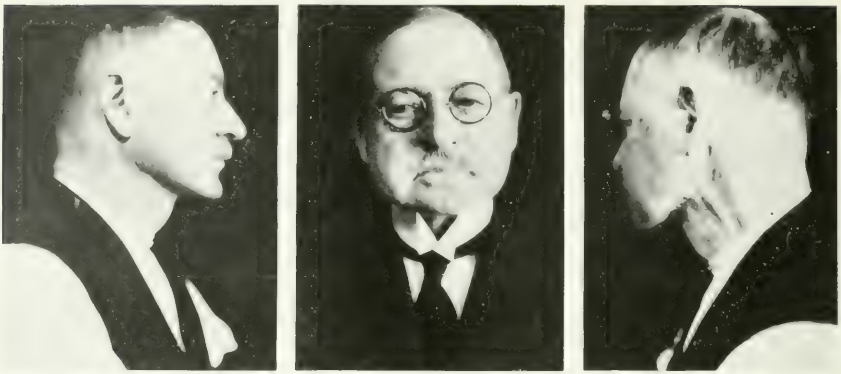

Fig. 1.—End result of bilateral block dissection of glands of neck for carcinoma of the tongue. Nine years after operation.

of this barrier is readily accessible to the surgeon. After the lymphatic stream has been blocked by carcinomatous invasion, it may flow in any direction, and every sort of irregularity in the further metastases may follow, but the metastases will still remain within the accessible lymphatic collar.

As far as metastatic dissemination is concerned, therefore, cancer of the head and neck presents a far more favorable outlook than does cancer of the breast with its thoracic and abdominal metastases or cancer of the stomach or intestines with its inaccessible retroperitoneal and liver metastases.

Within the lymphatic collar, because of the rich supply of lymph nodes and their connecting channels, metastases are rapidly disseminated, although cancer of each part of the head seems to follow a law of its own so far as its primary extension is concerned. Thus, cancers of the skin, of the mucous membrane of the cheeks, of the mucous membrane of the edge of the jaw, usually do not metastasize; cancers of the lip almost uniformly metastasize to the lymphatic glands under the jaw; cancer of the floor of the mouth usually metastasizes in the glands of the same side. Paired organs or distinctly one-sided foci usually metastasize regularly; while unpaired organs, as the tongue, or mesial tissue, such as the middle of the lip, metastasize irregularly and widely. For example: a marginal cancer of one side of the tongue may metastasize to the glands of the opposite side, although usually low down toward the clavicle, although the metastasis may occur at any site, high or low, on the right or the left side.

These facts give us the key to our *first principle* —the removal *en bloc* of the pertinent lymphatic glands. Thus, early cancer of the mucous membrane of the gingivæ or cheek which metastasizes late does not demand excision of the glands; while cancer of the lip, however early, demands the complete excision of all lymph nodes which drain the involved area; and cancer of the tongue or of the lip calls for the complete removal of the glands of the neck on both sides. Cancer of the jaws which metastasizes rarely, and usually on the side of the lesion, demands a less radical operation.

In advanced cases, no matter where the primary lesion, a wide regional block excision is demanded. Complete bilateral excisions can be made with an interval of several weeks without fear of ill results, the easiest technique involving excision of the sternomastoids and of both jugular veins *en masse* with the lymphatics. The disfigurement is not striking; and since the adoption of this method in 1898–1899, we have rarely missed

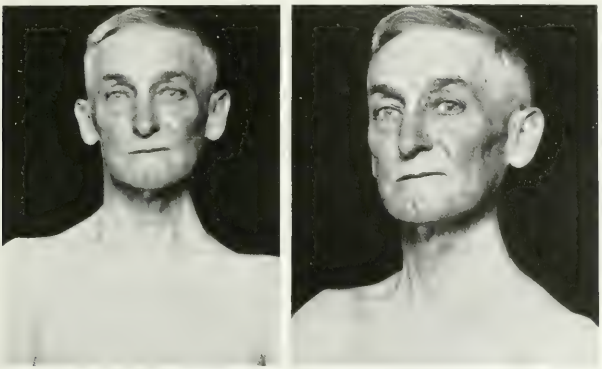

Fig. 2. End-result of bilateral dissection of glands of neck for epithelioma of the lip. Fourteen years after operation.

securing a permanent cure in any case which had not progressed beyond the lymphatic planes of the neck.

The second fundamental principle is suggested by the fact that the most common cause of death after operations which involve the mouth is bronchopneumonia resulting from the inhalation of blood or of wound secretion. The inhalation of blood or of wound secretion, therefore, must be prevented at any cost. This is accomplished by scrupulous hæmostasis during operation and by means of tubage and gauze packing of the pharynx; by administering the inhalation anæsthetic through rubber tubes passed through the nares; by intralaryngeal catheterization; by maintaining the lightest possible degree of anæsthesia, the main dependence being placed upon local anæsthesia, so that the conscious patient can aid in the prevention of inhalation of blood. Deep ether or chloroform anæsthesia are especially unfavorable on account of the danger of postoperative vomiting and a fatal inhalation of fluid. Ether is contraindicated also because it increases the danger of pneumonia.

Inhalation of blood or wound secretion after the operation is controlled by the attention of specially trained nurses, who are on duty continuously day and night, keeping the wound constantly clean and free by means of moist cotton pledgets, sprays, and washes.

The third principle is the prevention of a resowing of the cancer by wide excision and by the control of hæmorrhage. Hæmorrhage necessitates sponging. Sponging involves the surface of the cancer so that cancer cells may adhere to the sponges and be resown upon the fresh and fertile field. A resultant new-growth may kill the patient much earlier than the primary lesion would have done.

In the case of a cancer of the tongue, hæmostasis may be secured by a preliminary ligation of the linguals; or a dry field can be insured by the employment of mattress sutures in a wide zone around the focus.

CHOICE OF OPERATIVE METHOD

In certain cases cauterization is the method of choice for the removal of the primary focus. It must be borne in mind, however, that carcinoma of the jaws is usually the result of direct extension from the primary foci on the mucous membrane. Surgically two courses are open—one of which is to remove with a chisel or saw a margin of bone underlying the entire field of invasion with a sufficient adjacent margin of uninvaded tissue. That is, the incision around the cancer area to be excised is carried down to the underlying bone, and thence into the bone by

Fig. 3.—End result of unilateral block dissection of glands of neck for carcinoma of the lip. *a*, Thirteen years after operation; *b* and *c*, sixteen years after operation.

a sharp chisel or saw, so that a slice of the bone can be split off in one piece, bearing the undistributed cancer as on a bone platter.

Cancer within the mouth may be destroyed completely and more easily by the cautery than by surgical operation. But it must be borne in mind that straight surgery produces the best scars. The cautery, especially in cases of cancer of the cheek or well back on the jaw sometimes produces badly contracting scars. In several of my cases the scar contracted so as to set the teeth as in lockjaw, demanding a plastic operation. A plastic operation in a postoperative cancer field should be avoided. In general, we favor the use of a single postoperative high voltage X-ray treatment along with radium.

Our conception of the principles involved in operations upon cancers of the cheeks, lips, jaws, and tongue may be summarized as follows:

1. The primary focus may be destroyed by a cautery or removed by excision.

2. Local excision of only the primary focus of the tongue, lip, and floor of the mouth, leaving the regional lymphatic glands, is as ineffectual as excision of the breast without removal of the regional glands.

3. Excision of individual lymphatic glands not only does not afford permanent cure, but is usually followed by greater dissemination and more rapid growth.

4. The logical technique is a complete block excision of the regional lymphatic system together with a wide excision of the primary focus.

5. In operations for cancer of the buccal mucous membranes, a "platter" of underlying bone should be removed together with the intact growth.

6. No cancer tissue should be cut or handled.

7. The inhalation of blood and of wound secretion must be rigidly prevented during and after the operation.

8. Ether and chloroform should be used with greatest caution if at all; gas-oxygen combined with local anæsthesia or local anæsthesia alone is the choice.

9. A single treatment with deep, accurately measured X-ray or radium dosage is employed after operation.

10. The records of operations by my associates and myself include 224 cases of carcinoma of the buccal surfaces—lip, mouth, tongue, jaws, with 6 operative deaths.

CARCINOMA OF THE TONGUE

General Principles Involved in Operations and Results Obtained at Mayo Clinic [1]

By EDWARD S. JUDD, M.D., Rochester, Minnesota
Mayo Clinic

AND

GORDON B. NEW, M.D., Rochester, Minnesota
Section on Laryngology, Oral and Plastic Surgery, Mayo Clinic

In spite of the fact that cancer of the tongue, because of its location, is detected in the early stages, the results of treatment have not been satisfactory, chiefly because physicians and dentists have not appreciated the importance of the treatment of precancerous conditions, and of diagnosing and treating early malignancy. In many instances early lesions are not treated, or they are only superficially cauterized, or treated with radium or silver nitrate. The patient is then dismissed from observation, and these almost insignificant lesions gradually progress to conditions of hopeless malignancy. We are beginning to derive benefit from Bloodgood's propaganda of directing the attention of the members of the medical and dental professions, and the laity to this important subject. Such campaigns will probably do more than improved technique, or the employment of any of the newer agents for the treatment of cancer. It is the duty of every physician who is consulted with regard to an apparently insignificant lesion completely to remove the lesion and to determine its exact character as early as possible.

ETIOLOGY

Leucoplakia, particularly the papillary type, is one of the best examples of a definitely benign lesion becoming malignant. Usually such a lesion remains almost quiescent or at least changes little over a period of years and then develops into an active type of cancer. We believe that every case of leucoplakia is curable if treated early; if treatment is postponed until malignant change occurs, certain cases only will be curable. A review of our cases of cancer of the tongue reveals that many of the patients had known of the existence of an area of leucoplakia for some time.

In several cases of cancer of the tongue in old people, repeated treatment for thrush has been the predisposing factor. Syphilis is often a factor in the etiology. If the lesions of syphilis and cancer existed independently, more definite conclusions might be reached, but since the lesions are often present in the same ulcer of the tongue, the problem is complicated. The cancer in such cases probably arises from a gumma, in an old syphilitic scar, or in syphilitic leucoplakia. The areas of epithelial hyperplasia commonly seen in syphilitic tongues may be the beginning of cancer. Many patients who have responded to treatment for syphilis have been carried into a hopeless malignant condition because the double lesion was not recognized. This possibility should be kept constantly in mind in the examination of cases of ulcer of the tongue. If the patient gives a history of syphilis or has a positive Wassermann reaction, the lesion on the tongue may still be epithelioma. In Quick's series of 148 cases, 35.1 per cent gave a history of syphilis or of positive Wassermann reactions, and he believed that the incidence of syphilis is even greater than this. We have not sufficient data concerning our earlier cases on which to base accurate estimations, but we are inclined to believe that syphilis was coincident with cancer in even a greater percentage of cases than in Quick's series, and that in many, particularly in the younger patients, the epithelioma was secondary to the syphilitic lesion.

Besides the leucoplakias and syphilitic ulcers of the tongue, small cracks and benign ulcers are often observed, and occasionally hard, rounded fibromata and papillomata. As benign lesions these are of no consequence, and generally do not cause pain or inconvenience. Nevertheless, in reviewing the his-

[1] Presented before the Clinical Congress of American College of Surgeons, Boston, October 26, 1922.

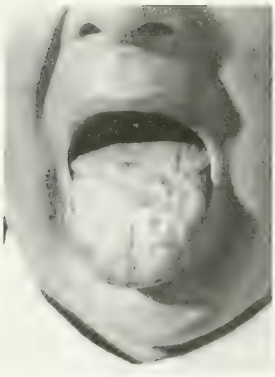

Fig. 1.

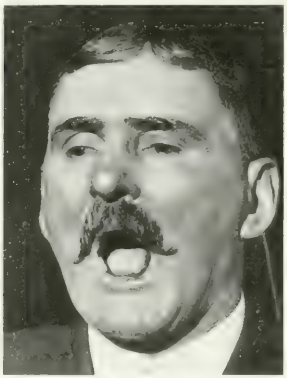

Fig. 2.

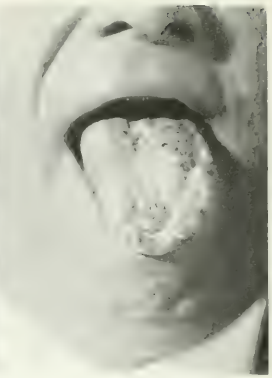

Fig. 3.

Fig. 1. Syphilitic leucoplakia of the tongue. Note the fissure down the center of the dorsum of the tongue. (A369031.)

Fig. 2. Syphilitic leucoplakia of the tongue. Note the leucoplakial epithelioma just inside the right angle of the mouth that apparently developed from a syphilitic lesion. (A178521.)

Fig. 3. Syphilitic leucoplakia of tongue. Areas posteriorly on dorsum of tongue are beginning to change and show, microscopically, epithelial hyperplasia. (A275425.)

tories of cases of cancer of the tongue, we find that one of these conditions may have been present for some time before the lesion became malignant. Undoubtedly, in most of these, the benign lesion was precancerous, and its removal, as such, would have prevented malignancy.

Dentists can do a great deal to prevent cancer of the tongue. An old broken or roughened tooth in constant contact with the border of the tongue may result in ulcer formation and later in epithelioma. Proper attention to the teeth might have prevented the original ulcer and wide excision of the simple ulcer instead of repeated local treatment might have prevented the development of the epithelioma.

In about nine of ten instances cancer of the tongue occurs in men. Personal habits, particularly the use of tobacco, undoubtedly are factors. The irritation from a pipe, and the heat and irritation from cigar or cigarette should affect the lip more often than the tongue; however, the excessive use of tobacco in any form, particularly the irritation from snuff, might affect the tissues of the mouth. Broders, who has made an analytical study of epithelioma of the lip, is inclined to believe that smoking as an etiological factor in the production of lesions of the lip and tongue is considerably overestimated. While the habit of using tobacco may be a factor, irritation from this source can be greatly reduced if the mouth is kept clean. Ulcers of the tongue and of the mouth are excellent illustrations of precancerous lesions. Patients are aware of the lesion early, and with such knowledge it should be possible completely to eradicate ulcers and tumors of the tongue early, and thereby reduce the number of cases in which operation is sought at a time when little or nothing can be done.

DIAGNOSIS

Cancer of the tongue must, in many instances, be diagnosed microscopically. Syphilitic lesions, such as gumma of the tongue, thickened leucoplakia, papillary areas that show only epithelial hyperplasia microscopically, or broken-down tuberculoma of the tongue not associated with pulmonary tuberculosis, may simulate cancer. The hypertrophy of the papillæ on the margin of the tongue posteriorly, which often causes the patient a great deal of trouble should not be treated locally. If there is a suggestion of malignancy, the area should be excised.

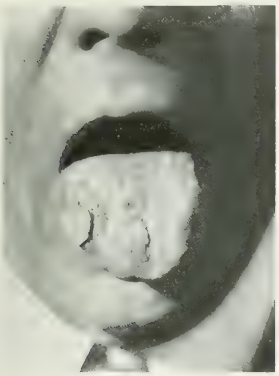

Fig. 4a.

Fig. 4b.

Fig. 4. Syphilitic leucoplakia of the tongue with epithelioma at the right margin. Note the fissure in the center of the tongue, and the epithelioma on the right margin, one stage further advanced than shown in Figure 3. (A295488.)

Fig. 5.

Fig. 5. Marked leucoplakia of the tongue with an epithelioma on the right margin near the tip. No definite syphilitic cause. The patient was a very heavy smoker. (A387257.)

Infected cysts, or the more unusual conditions of actinomycosis and blastomycosis, must be excluded. We have seen five patients with actinomycosis of the tongue in the last three years in two of whom a radical operation was recommended for malignancy. Fibromata or warts, particularly if they have been treated, may suggest a malignant condition. The most common differential diagnosis is of syphilitic lesions, simple ulcers, or cancers. It would not be permissible to excise an area of the ulcer and wait for the diagnosis; neither would it be permissible to perform a radical excision of a presumably malignant ulcer of the tongue before a microscopic diagnosis had been made. In such cases tissue should be excised for diagnosis and if it is malignant, the entire ulcer should be removed immediately. The tissue removed should be an area at the margin of the ulcer at the juncture of the normal epithelium and the ulcer, and not at the base of the ulcer. If the ulcer has been treated locally, a report of inflammatory tissue from the pathologist should not be considered absolute.

A high percentage of recurrences follows operations for cancer of the tongue, largely because many patients are operated on at an advanced stage of the disease. The most favorable situation for the tumor is at the tip of the tongue, although only a small number occur at this point; many are found on or near the lateral border. Treatment is more satisfactory if the lesion is on the dorsum and does not encroach on the mucous membrane of the floor of the mouth. Lesions at the root of the tongue are difficult to treat and the results are the least satisfactory. The greater number of such patients present themselves for treatment between the ages of 45 and 60 years. If no treatment is given, the average length of life is about one year.

Cancer of the tongue is nearly always squamous-cell epithelioma. The cylindrical-cell tumor is the exception. The tumor arises from the superficial epithelium or from the epithelial cells of the glands. About 70 per cent of the recurrences occur in the lymph nodes and not in the scar of the operation (von Bergmann, Kuettner). The lymphatic vessels from the mucous membrane and from the deep tissues of the tongue apparently have a single outlet which also takes up the lymph stream from the floor and walls of the mouth. On injecting any area of the tongue the dye is carried to all the glands within the lymphatic system of the tongue, so that the glands on either or both sides may become involved

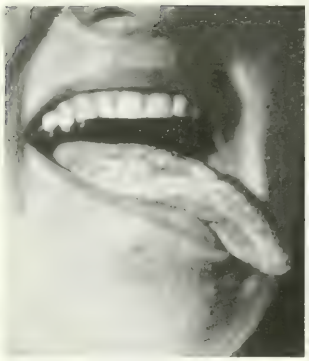

Fig. 6.

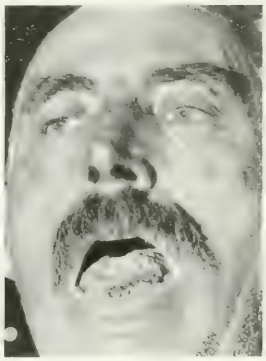

Fig. 7.

Fig. 8.

Fig. 6. Early epithelioma of the right margin of a woman's tongue, secondary to a leucoplakia. Syphilis not demonstrated as a factor. (A116365.)

Fig. 7. Actinomycosis of dorsum of tongue. Note crater-like ulcer. Referred for malignancy of tongue. (A374014.)

Fig. 8. Epithelioma of tip of tongue secondary to thrush, in a patient aged seventy years. Note the white patches (thrush) around the epithelioma near the tip of the tongue (A202825.)

from a growth on any part of the tongue. The gland in front of the internal jugular below the submaxillary group of glands, and one in the deep cervical group just posterior to the submaxillary group are often involved. We have often found these glands affected when it had been impossible to palpate them. If the growth is on the under surface of the tongue, and particularly if the floor of the mouth is involved, there will usually be an early extension to the lymph nodes as well as to the tissues around the inferior maxilla. This extension makes an unfavorable prognosis.

SUMMARY OF RESULTS AT VARIOUS CLINICS

Butlin, in a review of 197 cases of cancer of the tongue, in which he operated, reported that 55 patients (27.8 per cent) were well from 3 to 23 years. None of his patients remained well following operations for recurrence. He says that death was most often due to recurrence in the lymph nodes and not to recurrence of the lesion. The results of operative treatment reported by Bloodgood in his series of 260 cases was 62 per cent of five-year cures for patients operated on in the early stages, and 12 per cent of five-year cures in advanced cases. As he points out, such patients must be operated on early, and operation in the advanced stages cures only a small percentage of patients. Capetti analyzed 777 cases in which operation had been performed in various places and in all stages of the disease. Eighteen per cent of the patients were free from trouble at the end of three years. Caird reported 60 cases and 16 surviving patients. Lathrop and Scannell reported 30 cases from the Boston City Hospital. One patient was alive at the end of 7 years, and one after 5 years. Cobb and Simmons reported 56 cases from the Massachussetts General Hospital, in which 34 patients were operated on with 14.3 per cent cures; all of their cures were in elderly persons. Quick has given a very comprehensive report of the results of the treatment of cancer of the tongue with radium at the Memorial Hospital. He believes that with surgical treatment 75 to 90 per cent of cases will terminate fatally. In his series, only 23 per cent were operable. He asserts that surgery has no place in the treatment of the local lesion, that as long as the lymphatics are nature's barriers, they should not be removed unless they are involved, and that extension to the lymph nodes is embolic and therefore they should not be removed surgically. We have always believed

that in any malignant case, it is better to remove the lymphatics that drain the involved tissues. We have obtained much better ultimate results in operations for cancer of the breast, lip, and particularly the stomach, since we have routinely removed the lymphatics adjacent to such structures. The most satisfactory results have been obtained in cases in which the lymphatics were not found to be involved. If operations were postponed until lymphatic involvement was evident, the ultimate results were very unsatisfactory. Quick reports 148 cases, treated entirely with radium, in the past three and one-half years. The average duration of symptoms was 6.72 months; in 45.8 per cent of these cases the lymph nodes apparently were not involved.

TREATMENT

There can be no question concerning the value of the use of radium in the treatment of malignancy under certain circumstances, but clearly operable cases should not be treated with radium. All patients whose conditions are inoperable are given radium treatment, or they are directed to take such treatment elsewhere. Many early operable cases are made inoperable by the use of radium. Precancerous conditions should not be treated with radium. We have seen many cases in which the surface area had been scarred over, but the original lesion had become active underneath, eventually culminating in a hopeless condition.

Quick was the first to report a large series of cases, and since many of these are recent, more time must elapse before it can be determined whether or not radium should supplant surgery in the treatment of cancer of the tongue. There is no question concerning the value of radium as a palliative measure, or if surgery is contra-indicated in advanced cases. During the last few years, since the advent of radium, all the surgical patients have had, besides the surgical treatment outlined, radium applications over or into the tongue, and outside of the neck.

RESULTS OF TREATMENT: MAYO CLINIC

From January 1, 1910, to January 1, 1922, 303 patients came to the Clinic because of cancer of the tongue. We considered that the conditions of 185 (61.05 per cent) of these were inoperable, leaving a little less than 40 per cent operable. The variation in statistical results in these cases will be largely due to what one considers operable and inoperable cases. In early cases the patients almost invariably do well; in advanced cases the results are less favorable and yet a certain proportion of patients, even in the late stages, can be cured and should be given the chance. The ultimate results, as a series, should not be compared with the series made up entirely of early cases. Many of the deaths reported were due to other conditions, and, of course, the death rate in persons of these ages is naturally high. Therefore, it is difficult to obtain an accurate estimate of the percentage of cures. The statistics in this paper were estimated according to the reports returned in answer to questionnaires.

Of the 118 operable cases, 52 patients at an average age of 52.32 years, had involved nodes at the time of operation, while in 66 at an average age of 53.41 years, the lymphatics were free. We have recently had reports from nearly 80 per cent of these cases, and find that 30.85 per cent are free from disease more than 3 years; 24.46 per cent more than five years; 7.44 per cent more than 8 years; and 4.25 per cent more than 10 years.

TECHNIQUE

Our operative procedures have varied somewhat during this interval, but the general principles have been much the same. Most of the patients were operated on in two stages, the first stage consisting of removal of the cervical lymph nodes. If these were found to be involved, we have usually performed complete block dissection on the affected side with the removal of the submaxillary and the upper part of the deep cervical glands on the opposite side. If the glands were not involved, we removed the submental, the submaxillary, the upper part of the deep cervical, and the glands situated in front of the internal jugular vein. After these wounds have healed, in a few days to a week, the lesion of the tongue is removed by means of wide excision extending well into normal appearing tissue.

TABLE I.—A STUDY OF THREE HUNDRED AND THREE CASES OF EPITHELIOMA OF THE TONGUE FROM JANUARY 1, 1910, TO JANUARY 1, 1922, SHOWING END-RESULTS

	Total	Per cent	With glandular involvement		Without glandular involvement	
			Cases	Per cent	Cases	Per cent
Three year cures	[illegible]	[illegible]	8	17.62	[illegible]	44.68
Five year cures	[illegible]	4.46	[illegible]	10.63	18	38.29
Eight year cures	7	7.44	0	.	7	14.89
Ten year cures	4	4 [illegible]	0	.	4	8.51

TABLE II.—END-RESULTS IN PATIENTS WITH AND WITHOUT GLANDULAR INVOLVEMENT

	With glandular involvement			Without glandular involvement		
	Living	Dead	Total	Living	Dead	Total
Lived less than 1 year	0	10	10	0	7	7
Lived 1 to 2 years	2	4	6	4	5	9
Lived 2 to 3 years	1	4	5	2	2	4
Lived 3 to 4 years	1	2	3	2	1	3
Lived 4 to 5 years	0	0	0	0	0	0
Lived 5 to 6 years	3	0	3	4	1	5
Lived 6 to 7 years	0	1	1	4	0	4
Lived 7 to 8 years	0	0	0	2	0	2
Lived 8 to 9 years	0	1	1	0	1	1
Lived 9 to 10 years	0	0	0	2	0	2
Lived 10 to 11 years	0	0	0	1	0	1
Lived 11 to 12 years	0	0	0	3	0	3
Hospital mortality	0	1	1	0	0	0
Not stated	0	8	8	0	6	6

TABLE III.—PERCENTAGE OF OPERABLE AND INOPERABLE CASES

	Patients	Per cent	Hospital mortality	Per cent
Number	303			
Inoperable	185	61.05		
Operable	118	38.94	1	0.84
Males	101	85.59	1	0.99
Females	17	14.4		
Operable patients with glandular involvement	52	44.06	1	1.92
Operable patients without glandular involvement	66	55.93		

	Males	Per cent	Females	Per cent
Surgical	101	85.59	17	14.4
Inoperable	161	87.02	24	12.97

TABLE IV.—AGE INCIDENCE IN ONE HUNDRED AND EIGHTEEN OPERABLE CASES

Years	With glandular involvement		Without glandular involvement		Total	Per cent
	Patients	Per cent	Patients	Per cent		
30 to 40	5	9.61	9	13.63	14	11.86
40 to 50	18	34.61	16	24.24	34	28.81
50 to 60	13	25.00	18	27.27	31	26.27
60 to 70	15	28.84	15	22.72	30	25.42
70 to 80	1	1.93	8	12.12	9	7.62
Youngest	31 years		Youngest		32 years	
Oldest	71 years		Oldest		75 years	
Average age	52.32 years		Average age		53.41 years	

TABLE V.—FOLLOW-UP RECORD IN ONE HUNDRED AND EIGHTEEN OPERABLE CASES

	Patients	Per cent	Average length of disease, months	Average length of life after operation, months
Traced	94	79.66	14.55	36.07
Living	81	82.97	17.78	63.51
Dead	63	67.02	11.99	18.56
Fifty-two with glandular involvement				
Traced	47	90.38	12.40	21.62
Living	7	14.89	10.14	42.85
Dead	40	85.1	12.44	16.83
Sixty-six without glandular involvement				
Traced	47	71.21	16.09	45.02
Living	24	51.06	19.45	69.54
Dead	23	48.93	13.80	20.50

The functional result is as good in a fairly wide removal as in a lesser one; nothing is added to the operation by being more radical in this step. We prefer to make the excision with the cautery.

Our operative mortality at the clinic has been low, and we believe that this is due first, to the fact that we have not accepted altogether hopeless cases, and second, to the fact that we have performed the operation in two stages.

We have classified the types of treatment for cancer of the tongue as follows: (1) cautery excision, (2) cauterization, (3) excision with the knife, (4) the Kocher operation, and (5) radium locally and removal of the glands. We have not had any experience with the radical cautery operation as performed by Blair, but believe that it is based on sound principles and that it should be used when extensive operation is indicated.

Cautery excision is the type of operation preferred, although in cases of considerable involvement in the floor of the mouth we have sometimes used the Percy cautery. In seven cases we have used radium for the lesion on the tongue and removed the glands. Six of these patients have been traced; only one is living. This is not a fair test of the use of radium, however, since radium was used in

these cases because the local lesion was too extensive to be excised satisfactorily.

We have performed the Kocher operation in six cases, that is, dividing the inferior maxilla in the middle line and removing the floor of the mouth, the tongue and the glands. This type of operation was used in these cases because of the extensive involvement of the tissues in the floor of the mouth. The patients were all operated on a number of years ago. Several of them lived comfortably for a time, but eventually died of recurrences.

CONCLUSIONS

1. A reduction in the number of cases of cancer of the tongue depends on the early recognition and proper treatment of precancerous lesions.

2. Lesions of the tongue, suspected of being malignant, should be excised for diagnosis, and should not be treated locally.

3. Improvement in the end-results of treatment of cancer of the tongue depends on early diagnosis and proper treatment in the early stages of the disease.

4. With our present knowledge, all patients with operable cancers of the tongue should be given the benefit of surgery, including cauterization of the local lesion and excision of the glands of the neck. Radium should also be employed in order to give these patients every possible chance.

CARCINOMA OF THE LIP AND CHEEK

General Principles Involved in Operations and Results Obtained at Presbyterian, Memorial, and Roosevelt Hospitals [1]

By GEORGE EMERSON BREWER, M.D., F.A.C.S., New York

In grouping together cancer of the lip and cancer of the cheek, your committee has assigned to me the task of presenting to you this evening, a brief résumé of our present knowledge of the general behavior of malignant disease arising in these two adjacent areas of mucous membrane. This should include a consideration of the relative frequency of the different types of growth in each; the known facts in regard to their etiology; the development of their operative treatment; and the chances of cure which reasonably may be expected to follow their treatment by modern surgical measures.

Malignant disease in these two areas, situated as they are so closely together that one could with difficulty state where the one ends and the other begins, they nevertheless present such differences in frequency; in clinical progress; in extension to other structures; in accessibility to radical treatment and in ultimate results, that one could almost affirm that in prognosis they represent the two extremes of hope and despair.

As the combined statistics of the Presbyterian, Roosevelt, and General Memorial Hospitals for the past 10 years give only 415 cases of cancer of the lip and cheek, a number far too small for accurate conclusions, the writer has collected reports, more or less complete, from thirty-one surgical clinics, totalling 3,889 cases—11 of these reports were published prior to 1900, 20 since that date.

Cancer of the lip while of fairly frequent occurrence is by no means one of the commonest manifestations of malignant disease. From an analysis of records of hospital admissions, one can state that in from 2 to 3 per cent of cancer subjects seeking treatment, the primary disease is located in the lip. Cancer of the lower lip is about twelve times as frequent as cancer of the upper. In an analysis of lip cancer from five surgical clinics, it was found that of 694 cases, in 637 the disease was primary in the lower, and in 57, the upper lip. In 35 both lips were involved. There is also a very marked difference in regard to sex. About 95 per cent of the cases occurring in males (941 males; 40 females).

These facts strongly incline one to look for some definite etiological factor. The one most frequently mentioned is tobacco smoking. The constant irritation of the formerly much-used clay pipe, with its heat and tendency to

[1] Presented before the Clinical Congress of American College of Surgeons, Boston, October 26, 1922.

adhere to the mucous membrane of the lower lip, was thought by many to be the most important source of lip cancer. More recently José Ribera of Madrid called attention to the constant irritation caused by the almost universal habit among Spanish men of smoking cigarettes and of allowing them to remain in contact with the lip until nearly consumed, as constituting a definite etiological factor.

Louis Bradford Couch, in discussing the subject in 1911, pointed out the three important factors in the relationship between tobacco smoking and lip cancer: first, local anæmia caused by pressure of the pipe stem on the lower lip; second, the irritating effect of nicotine and the products of combustion, carbon monoxide and carbon dioxide making with the water of the mouth secretions carbonic acid; and third, the direct action of heat.

It is an interesting and significant fact, that while cancer of every kind is far less frequent in the colored race, the vital statistics of the District of Columbia show that among deaths of women over 70 years of age, 8.04 per 100,000 of white women die of cancer of the lip, while in negro women, a large proportion of whom smoke clay pipes, the rate is over 30.1. Among other etiological factors may be mentioned seborrhœic keratoses and small papillomata, both of which are not infrequently found on the lower lip; irritation from diseased teeth or badly made plates; cracks from chapped lips; leucoplakia; herpes labialis; minute cuts from the habit of shaving too closely along the muco-cutaneous border; direct blows, or the stings of insects. While these and many other factors often are blamed for the occurrence of cancer, experience teaches that we must regard only the sources of more or less constant irritation, as causative agents here as in cancer elsewhere; and of these smoking, cracks, papillomata, and keratoses undoubtedly are the most important. Of the different types of malignant disease occurring in the lip, only three deserve consideration: (1) squamous epithelioma, (2) basal-cell epithelioma, and (3) sarcoma.

While few of the reports give accurate descriptions of pathological findings, and while even in the best there is a remarkable variation in terms employed to describe the type of neoplasm, still, from the available data, the writer feels justified in stating that fully 95 per cent of malignant tumors of the lip should be classified as squamous epithelioma.

In a series of 333 cases taken from the records of the Presbyterian, Roosevelt, and the General Memorial Hospitals, there were no cases of sarcoma, and but eight cases of basal cell tumor, making the percentage of the latter 2.4 per cent.

Ewing describes two clinical types of epidermoid cancer of the lip, the papillary and the ulcerative infiltrating variety.

The papillary occurs as a wart-like, elevated lesion, situated in or on the epidermis, and for a long period is unaccompanied by deep or subepithelial induration. It extends slowly in all diameters, finally ulcerates, penetrates the underlying tissue, involves the anatomically related lymph nodes, and in the end closely resembles the second or more malignant variety.

The ulcerative infiltrating type begins as a broad thickening of the epidermal layer, with early dense infiltration of the deeper structures, and the formation of a crater-like ulceration surrounded by a definite, indurated border. It advances more rapidly than the papillary type, involves the lymphatic structures earlier, is surrounded by an area of œdema, and not infrequently becomes infected and undergoes extensive necrosis.

While visceral metastases are rarely present in neglected cases of both varieties, they are more frequently encountered in the latter type, and may be found in the mediastinum, liver, lungs, heart, and adrenal glands.

Lymphatic extension in cancer of the lower lip is almost invariably first observed in the submental nodes, from these it extends to the submaxillary group, thence to the upper and, finally, to the lower cervical groups, both superficial and deep.

In cancer of the upper lip, the submental nodes often are not involved, the disease being carried first to the nodes adjacent to the submaxillary salivary gland, or to the upper deep cervical group.

While in the great majority of instances early lymph node metastases occur on the same side as the primary lesion, this is not

always the case, as numerous examples have been reported in which the earliest lymph node involvement occurred on the side opposite to the primary growth.

Judd, in 1908, called attention to the fact that the submucous lymphatics of the lower lip drain into the submental nodes, while the adjacent subcutaneous lymph vessels almost all pass to the nodes surrounding the submaxillary salivary glands. He also stated that while the salivary gland was never actually involved in the early stages of lymphatic metastases, its removal was strongly indicated, for the reason that numerous lymph nodes were in close relation with it and often occupied deep recesses in the gland substance although lying without its capsule.

These views were later confirmed by Beckman, who advocated complete removal of all nodes, lymph-bearing areolar tissue, and the submaxillary glands on both sides; and if disease could be demonstrated in these structures, to make a complete block dissection of the neck on the side of the involvement. This author also stated that he had failed to find evidences of cancer in the lymphatic vessels leading from the primary lesion to the involved nodes, which tends to confirm the view expressed by Ewing, that in this region at least, the lymph node metastasis was an embolic process rather than a direct growth of malignant cells along the lymph channels. If this view is correct it would justify the technique now almost invariably followed by surgeons in early cases, of leaving intact the tissues lying between the operative wound of the primary lesion and the one for the removal of the related lymph nodes beneath the jaw.

In late cases, especially where infection is present, extension of the disease is rapid, the original lesion invading the tissues of the cheek, the chin, the mandible; and the lymphatic metastases spreading to nodes beneath the lower border of the parotid gland, and to the deep cervical chain. Bloodgood states that he has never seen an operative cure if the subparotid nodes were involved, or if the disease had invaded the jaw bone.

Basal-cell epithelioma of the lip is an exceedingly rare affection, and is somewhat more frequent on the upper lip.

In 333 cases of lip cancer from the records of the Presbyterian, Roosevelt, and General Memorial Hospitals, it occurred but eight times; five times in men, and three in women. Five of the eight were on the upper lip, one on the lower, one at the angle of the mouth, and in one instance, the location was not mentioned.

Bloodgood states that the primary lesion always appears on the cutaneous side of the vermillion border. When first observed it is a small slightly elevated, oval, insensitive nodule. This increases in size very slowly, and for a long period remains superficial with but little or no subcutaneous induration. At a later period, the surface of the lesion ulcerates, leaving a superficial erosion, which later is surrounded by a narrow margin of induration. The ulcerated area slowly increases in diameter, the underlying tissues become indurated and on microscopic examination delicate strands of tumor cells are seen to extend outward in the healthy tissues, apparently following or filling the dilated lumina of lymphatic vessels. As in the case of rodent ulcer on other parts of the face, the disease, if untreated, may result in extensive loss of tissue causing great deformity.

This type of epithelioma differs entirely in its clinical manifestations from the squamous-cell variety. It is said never to result in visceral metastases, and very rarely invades the neighboring lymph nodes. In fact, its malignancy is so mild that some authorities fail to place it in the class of malignant neoplasms.

This view the writer feels is untenable for the reason that a number of cases are on record where the microscope has revealed both types of epithelioma in the same tumor; also a number of other cases in which the tumor may be said to occupy a position midway between the typical, mild, basal-cell growth and the frankly malignant squamous variety, in that it shows in places prickle cells; in other places cells from the middle layer of the epidermis, and in still other localities cells from the ducts of the cutaneous glands.

Although it is not the writer's intention in this brief clinical report to discuss at length the many pathological questions which may arise in regard to epidermoid cancer in gen-

eral, it may not be out of place just to mention the painstaking observations which have been made at the Mayo Clinic, with a view to explaining the varying degrees of malignancy clinically observed in different types of squamous-cell cancer of the lip. Broders, from an analysis of 537 cases, divided the cases into four groups, depending chiefly upon the degree of differentiation of the cells and the number of mitotic figures. He demonstrated in Group I, which shows the greatest degree of differentiation but with no mitotic figures, that the cures were 100 per cent, while in Group IV, which shows the opposite microscopic picture, the percentage of cures was reduced to zero.

If these observations are confirmed, in the writer's opinion, they constitute one of the most important contributions to the subject of lip cancer which has appeared in recent times, and may result in definite changes in operative technique.

Sarcoma of the lip is so rare as to constitute a veritable surgical curiosity. Three clinical types are recognized, the hard, slowly growing fibrosarcoma, of feeble malignancy; the soft, rapidly advancing round-cell tumor, and the melanotic variety, the two latter being exceedingly malignant.

While no case of sarcoma of the lip appears in my records of the Presbyterian, Roosevelt, and the General Memorial Hospitals, two cases of fibrosarcoma were observed at the Vanderbilt Clinic, in which the diagnosis was confirmed by microscopic examination after local removal of the lesion, and a few examples of the more malignant varieties are to be found in hospital reports and current literature.

The number of such cases, however, is so small in comparison to the usual type of lip cancer, that they will not receive further attention in this report.

To give one some idea of the relative frequency of malignant and benign tumors of the lip, it may be stated that in a series of 34 lip tumors reported from the Vanderbilt Clinic and the Out-patient Department of the Presbyterian Hospital, there were: 19 epitheliomata, 2 fibrosarcomata, 7 fibromata, 3 papillomata, and 3 composite tumors, the proportion of benign to malignant being 13 to 21.

While all of these innocent tumors should be regarded as possibly precancerous lesions and should be removed, the composite growth, or so-called salivary gland tumors deserve more than a passing mention, as they occur more frequently in the upper lip, and their clinical diagnosis is not always easy.

As is well known, numerous small masses of aberrent salivary gland tissue are constantly found in the lips, lying between the mucous membrane and the orbicularis muscle. It was formerly believed that these small masses gave origin to these composite growths, tumors corresponding in type exactly to the mixed tumors found so frequently in the neighborhood of the parotid and submaxillary glands; and while recent investigation has thrown some doubt upon their exact origin, the fact remains that tumors of this class are not infrequently encountered in the lip. These tumors are at first encapsulated, lie beneath the mucous membrane, but not firmly attached to it. They are oval or irregular in shape, often with varying density owing to the presence of cartilage; fibrous, myxomatous, or glandular tissue. Generally they can be slipped about beneath the mucous membrane by the palpating fingers. They grow slowly, but if untreated may reach a large size causing marked deformity. As is well known, these tumors occasionally undergo malignant change, and it is not improbable that some of the rarer types of malignant tumors of the lip, as the alveolar or myxosarcomata, or some of the atypical examples of epithelioma, may have their origin in a lawless growth of either the connective tissue or epithelial elements of these complex growths.

In the development of the surgery of cancer of the lip, one recognizes several stages as in cancer of other regions. First the period of late diagnosis, and later incomplete local operation; with disastrous results, both immediate and remote, and with practically no permanent cures. Then as a result of earlier diagnosis, earlier operation, and improved technique, a lower operative mortality, and a few permanent cures. Still later when the importance of lymphatic extension began to be recognized, and the involved neighboring

lymph nodes were removed, more permanent cures were reported. Finally, when the regular routes of lymphatic extension were demonstrated; when the anatomically related lymph nodes and lymph-bearing areolar tissues were removed whether involved or not, the percentage of cures rose steadily, due to the thoroughness with which these principles were carried out, and more particularly to the fact that during the past decade, owing to popular education in regard to malignant disease, patients with suspected cancer seek surgical advice earlier, and show less procrastination in accepting operative treatment. Roughly speaking, the first three of these periods occurred prior to 1900, the last since that date, and is at present progressing.

During this early period, a number of carefully prepared reports appeared, which indicated that as a rule only the visibly and palpably diseased tissues were removed; and although the majority of the operations were only V-shaped excisions of the primary growth, the fact that in these reports a fair number of extensive neck and jaw operations were undertaken, would indicate that the operating surgeons were by no means timid in their attacks on late and wide-spread disease.

Thus Woerner, in 1885, reports from the Tuebingen Clinic 350 operations on 277 individuals of which there were 224 simple wedge-shaped excisions of the local lesion; 69 extensive local resections requiring plastic repair; 23 extirpations of the diseased glands; 26 more or less extensive resections of the lower jaw, and 8 of the upper. He further reports that 27 died as a result of the operation; 146 died of recurrence; 80 were living with evident recurrence; and 97 living and well: 89 over 3 years, or 32 per cent three year cures. Toward the end of this period Theodor Fricke, in 1898, reported 124 cases of which 8 died from operation; 33 from recurrence; 4 living with recurrence; 27 died from conditions other than cancer three or more years after operation; and 42 were alive more than three years without evidence or recurrence, making his statistics 55 per cent well at least three years following operation. Woerner collected the statistics from seven additional operators, namely Thiersch, von Bergmann, Billroth, Winiwater, Fischer, Koch, and Partsch, and combining these with his own, and those of Fricke mentioned above, we have 814 cases with 272 three year cures, or about 33 per cent.

These statistics, although they do not give us the percentage of cure in the various types of disease, as regards duration of the process before operation, or the extent of lymph node involvement, give us a fair estimate of the success of the world's best operators prior to 1900, the period before the exact routes of lymphatic extension were accurately known, and before the principle of removing all lymphatic drainage areas whether infected or not was generally adopted. They show moreover a gradual improvement in results from the earliest report of Thiersch in 1865 of 10 per cent three year cures to the latest by Fricke in 1889 of 55 per cent.

Let us now briefly consider the progress in operative technique and results since 1900.

The two most important contributions in the early part of this period were those of Crile to the Southern Surgical and Gynecological Society in 1906, and von Bonsdorff to the International Society of Surgery in Brussels in 1908.

In Crile's paper attention was called to the fact that in less than one per cent of the cases of cancer of the face, head, and neck, were remote visceral metastases found; but that the disease was almost invariably limited to the extensive collar of lymphatics surrounding the neck. He then described his method of block dissection with removal of all lymph nodes and lymph-bearing areolar tissue on one or both sides of the neck, where the upper or primary lymph nodes were involved. He reported that 12 of 46 cases so treated were well and free from recurrence three years after operation. His group included many examples of advanced long standing disease ordinarily regarded as hopeless.

Von Bonsdorff emphasized the fact that Volkmann's rule, that a three year freedom from recurrence constituted a cure in operations for cancer, was no longer tenable; as the statistics of Loos, Steiner, and Janowsky conclusively proved that in cancer of the lip, nearly 10 per cent of the recurrences occurred after

three years; and that a five year period should be the standard. He also described the distribution of the lymph vessels from the lip to the submental, submaxillary, and cervical chains, and advocated wide removal of primary growth without regard to the extent of plastic repair necessary; complete emptying of both submaxillary triangles in every case, and when indicated, complete block dissection on one or both sides of the neck, but without removal of the internal jugular vein and its branches, or of the sternomastoid muscle.

While sufficient time had not elapsed to report on his own cases in which this method had been followed, he reported two small series of cases of Steiner and Armknecht, in which methods similar to his own had been employed, showing in 44 cases of Steiner 70.45 per cent three year cures, and 72 per cent five year cures; and in 19 cases of Armknecht 94.7 per cent three year cures.

At the same meeting Dollenger reported a series of 200 cases of cancer of the lip of which 158 were primary. Late reports on these cases showed 70.7 per cent free from recurrence in three years, and 69.6 per cent five year cures.

A fourth series of 80 cases reported in 1906 by Hallstrom gives the percentage of three year cures as 63.73 per cent.

It will thus be seen that during the first decade of 1900, a marked improvement in results followed the advanced technique employed, the three year cures mounting from 33 per cent to 74 per cent; and two series of five year cures showing an average of 70 per cent.

In reviewing the histories of lip cancer treated in the Presbyterian Hospital and Roosevelt Hospital during the past ten years, the writer was surprised at the small number of cases, and at the comparatively low percentage of late reports.

At the Roosevelt Hospital there were 40 cases: males 36, females 1, sex not recorded 3. Lower lip 30, upper lip 4, both lips involved 1, not stated 5. Squamous-cell epithelioma, 36; basal-cell, 3 (2 males, 1 female); adenocarcinoma, 1; local operations only, 14; local removal and cervical glands on one side, 20; local removal and cervical glands on both sides, 1; glandular removal only, recurrent case, 1; cautery, curettage, X-ray, or radium, 4 cases.

At the Presbyterian Hospital there were 41 cases: males 37, females 4, upper lip 4, lower lip 37. Squamous-cell epithelioma, 38 (upper 37, lower 1); basal-cell epithelioma, 3 (upper 2, lower 1); local operation only, 11; local removal and neck dissection, 29, of which 25 were of the maxillary, submental, and upper cervical nodes; and block dissections, 4.

From the follow-up we find: 1 living 7 years after operation, 2 living 5 years after operation, 2 living 4 to 5 years after operation, 5 living 3 to 4 years after operation, 3 living 2 to 3 years after operation, 6 living 1 to 2 years after operation, and 3 less than one year.

In 17 cases operated upon more than three years ago, the end-results are recorded. Dividing these into three groups, we find that in Group I, local operation only, we have four cases: 1 dead 7 years after operation of recurrence, 1 living 5 years after operation with recurrence, 1 living 3¾ years after operation with recurrence, 1 living 1½ years after operation without recurrence.

This small group illustrates how misleading a three year standard of cure can be, for three of these cases passed the third year limit without recurrence; 2 passed the fourth, and one the fifth; yet all later developed recurrences.

Of 7 cases of Group II, local removal, with extirpation of submental and submaxillary glands—glands negative—all, or 100 per cent, are well and free from recurrence more than three years after operation. 1 more than 5 years, 2 more than 4 years, 4 more than 3 years.

Of 5 cases in Group III, in which glands were involved: 1 is living and well 4 years after operation, 1 is living 2½ years after operation with recurrence, 1 dead 1¾ years after operation with recurrence, 1 living 1½ years after operation with recurrence, 1 dead 9 months after operation with recurrence.

In one case, only the glands were removed, the primary operation six months before. This case had three operations, and was also treated by heat coagulation; died one year after primary operation.

If we except Group II in which we have 100 per cent three year cures, these results are disappointing, and in the writer's opinion are

due to the fact that submaxillary lymph node removal was not done in Group I; and only one block dissection was carried out in Group III.[1]

In 1908 Judd reported in a series of cases at the Mayo Clinic, where it was then the routine to remove the glands from both submaxillary triangles, the result in Group I, the percentage of three year cures was 25. In Group II the percentage was 69 plus.

In 1913 Beckman advocated dissection of both submaxillary triangles, and if involved nodes were found, complete block dissection of the neck on that side, with the result that in: Group I, his reported cures were 73.3 per cent; Group II, his reported cures were 83.8 per cent; Group III, his reported cures were 50 per cent.

In 1914 Bloodgood from an analysis of 200 cases at the Johns Hopkins Hospital, gives the results of cases operated upon more than five years. Group I, 10 cases, 63 per cent cured; Group II, 21 cases, 95 per cent cured; Group III, 6 cases, 50 per cent cured.

In 1921 Sistrunk reports on 136 cases at the Mayo Clinic. All operated upon five years or more before the report. Group I, 27 cases, 70.2 per cent living 5 to 8 years; Group II, 98 cases, 90.3 per cent living from 5 to 8 years; Group III, 11 cases, with block dissection in 6, 18.1 per cent living 5 to 8 years.

I have not attempted to obtain the latest results from the Crile or Mayo Clinics, as they are to be reported separately at this meeting; but comparing the results gleaned from the few selected reports given above with those published prior to 1900, it will be evident to all that great progress has been made.

If we unite the recent statistics of those clinics in which the five year standard has been adopted, and in which the highest type of technical work is being carried out, the following averages will be obtained.

Group I—in which only the primary lesion was removed, 66 per cent well and without evidence of recurrence five or more years.

Group II—in which the primary lesion and the anatomically related submaxillary lymph structures have been removed, but without lymph node involvement—92 per cent five year cures.

Group III—in which the primary lesion and related lymph nodes have been removed, but with positive evidence of involvement of the latter—34 per cent five year cures.

The limited time allotted to this report precluded the possibility of entering into any discussion of the question of recurrent cancer of the lip. The topics of diagnosis and operative technique are also omitted for the same reason, and also for the reason that before an audience such as this, these considerations are obviously unnecessary.

My report on cancer of the cheek will be exceedingly brief. If we exclude the Eastern tropical countries where betel nut chewing is practiced, primary cancer of the cheek may be classed among the rarer manifestations of the disease. Most of the reported cases are combined, either with malignant disease of the face, or of the mouth, and for this reason, accurate statistics are difficult to obtain.

Of 82 cases collected from the histories of the Presbyterian, Roosevelt, and the General Memorial Hospitals, 71 were in males, and 11 in females. Excluding four cases as of doubtful malignancy, and one in which the type was not mentioned, 75 were epidermoid cancer, and 2, basal-cell growths.

Morestin states that the most frequent site of the primary lesion is at or near the angle of the mouth. From there it quickly extends downward and backward, or upward and backward and soon involves the mandible or the upper jaw. In a study of the series mentioned above, it was found that the majority were so extensive that the location of the primary lesion was uncertain; but in 3 cases it was limited to the region near the angle of the mouth; in 8 it involved the alveolar border; in 4 the middle area of the cheek; in 7 the posterior area. In 59 of the cases it was described

[1] Since the above was written, Dr. Charles N. Dowd has kindly furnished me with the follow-up on 9 personal cases operated upon at the Roosevelt and General Memorial Hospitals, more than 3 years ago.

Of these 8 were well more than three years, and one, when last reported, was well one year and two months. Of the 8, well three years or more, one developed a recurrence after four years; and one died of cancer of the stomach six years after the primary operation. Of the remaining 6: One was well and free from recurrence 3 years and 1 month, one was well and free from recurrence 4 years and 7 months, one was well and free from recurrence 4 years and 10 months, one was well and free from recurrence 6 years and 1 month, one was well and free from recurrence 9 years, and one was well and free from recurrence 11 years.

In all of these the primary lesion was removed together with the related lymph nodes in one or both submaxillary triangles, and, when indicated, the upper and lower groups in the cervical chain.

as extensive, involving the jaws, lips, floor of the mouth, tongue, pillar of the fauces or vault of the pharynx. In 12 it had penetrated the cheek and appeared on the skin surface. In 8 cases it was associated with leucoplakia. Thirty-six of the cases could be classed as early (six months or under), 45 as late.

As the great majority of these cases were reported from the General Memorial Hospital, where they were treated with radium, but few radical operations occur in the series.

At the Roosevelt and Presbyterian Hospitals there were 11 cases. Of these 4 were inoperable; and in 7, radical operations were performed. The operations were: 3 radical excisions of the cheek with removal of submaxillary and cervical glands; 2 radical excisions with partial removal of mandible and cervical glands; 1 radical removal of primary growth with cautery. There was one operative death in the series, and no record of cures. J. Collins Warren, in 1908, reported to the International Surgical Association, 9 cases of cancer of the cheek at the Massachusetts General Hospital: 8 of these were operated upon, with two deaths. Of the 8 operations, 3 were local or palliative, and 5 extensive, including removal of the cervical glands, and in two instances, partial removal of the jaw. There were no cures.

Warren quoted Boyd and Unwin as reporting 10 cases. Four of the 10 had very extensive operations involving the jaw. No reported cures.

At the same meeting Morestin emphasized the extreme malignancy of these tumors and reported 25 operations, nearly all involving the jaw, with two well 2 years after operation.

C. G. Davis, in 1915, reported on 49 cases occurring at the Philippine General Hospital during his service in the Army, but was unable to report any permanent cures.

Dollinger reported on 61 cases. Eleven of these were limited to the mucous membrane of the cheek; the others involving other structures. In 26 the end-results were known: 3, three year cures, all in the limited cases. Meller reported 8 cases, with 2 cures, although the time was not stated.

Ribera reported 5 cases, but gave no end-results.

Of 117 operations mentioned above, there were only 3 reported three year cures.

From these scanty reports, I think we can assume that cancer of the cheek is a rare and exceedingly malignant disease, which quickly spreads to the upper and lower jaw, and to adjacent structures of the mouth, with early involvement of the cervical lymphatics. In all but the earliest cases, radical surgical treatment involves an extensive, disfiguring, and dangerous operative procedure, with but little hope of a permanent cure. In fact, I feel that most surgeons of experience will agree with G. B. New of the Mayo Clinic, in his statement that "the type of the disease which is primary in the cheek is exceeded in its malignancy only by melanocarcinoma."

This report would not be complete without a few words in regard to the treatment of these conditions with radium.

Dr. Quick, who is later to discuss these reports, was good enough to place at my disposal an abstract of the histories from the General Memorial Hospital, and while I have no intention of anticipating any remarks he may make, I would like to give a brief summary of the results.

While the earlier reports of the treatment of cancer by radium and other varieties of radiant energy, failed to impress surgeons as to its value in early operable cases, we are all aware that during the past 6 or 8 years, great progress has been made in the technique of these procedures, and in accurately estimating the proper dosage. As a result of much careful study, experimental experience, and painstaking observation, the results now obtained are far in advance of anything hoped for a decade ago.

Of 252 cases of cancer of the lip treated by radium at the General Memorial Hospital during the past 7 years, a large proportion so advanced that they were referred only for palliative treatment; there were 19 three year cures: 2 of these were over 5 years; 6 between 4 and 5 years; 11 between 3 and 4 years.

As only 70 of these cases were treated prior to July 1, 1919, it gives us 27 per cent of three year cures; 14 per cent four year cures; and 11 per cent five year cures.

In the series of cancer of the cheek treated at this hospital, it will be remembered that the great majority, 59 out of 67, were advanced cases involving large areas. In 61 of the 67, the end-results were determined as follows:

	Cases
Dead	15
Unimproved	13
Improved	6
Well 6 months	9
Well 1 year	11
Well 2 years	1
Well 3 years	3
Well 4 years	1
Well 5 years	1
Well 6 years	1

As only 15 cases were treated prior to July 1, 1919, it gives us 6, or 35 per cent three year cures.

This excludes one dead, three years and six months of recurrence, and does not include the four doubtful cases.

From the statistics of this report which I believe to be accurate, it will be seen that the results of surgical treatment of the lip are far superior to those as yet obtained by radium, and that we are not justified at the present time in advising radium treatment in early operable cases. On the other hand, in cancer of the cheek, the results by radium are so evidently in advance of those obtained by operation, that until it can be demonstrated by a series of well observed three or five year cases, that operation gives equally good results, all cancers arising in the mucous membrane of the cheek should be treated by radium.

Discussion

By A. J. OCHSNER, M.D., Chicago

In the discussion of these excellent papers, I can record my experiences as corresponding quite closely with those of the essayists.

Dr. Brewer's statistics are very convincing.

I have strenuously objected to the treatment of epithelioma of the lower lip primarily with radium or X-ray, because the results after excision of a square portion of the lower lip, never a V-shaped excision, and preliminary or subsequent careful treatment with X-ray have been so satisfactory that it has not seemed wise to make a change.

In advanced cancer of the cheek, the plan of surrounding the growth with a row of radium needles 0.5 centimeter from the outer edge of the growth, and later excising with the cautery, seems worth trying, although our cases are not sufficiently numerous, nor of sufficiently long standing to warrant any positive statement. The same treatment seems indicated for advanced cases of cancer of the tongue.

Dr. Judd's conclusions are equally convincing. I wish to emphasize especially the importance of immediate careful treatment of every case of leucoplakia, because this condition is always potentially malignant.

Above all things the use of tobacco in every form, including snuff, must be prohibited permanently. Decayed roots and rough edges of teeth must be removed, cleanliness in the care of the mouth must be insisted upon, and care must be exercised in the selection of clean food. Filth in the mouth seems to favor the development of cancer.

Extreme care must be exercised in differentiating between cancer of the tongue and gumma, tuberculosis, and actinomycosis. In case of doubt the growth should be excised with the electric cautery, never with the knife, and examined microscopically at once.

I agree fully with Dr. Judd's objections to temporizing and to local treatment with nitrate of silver or iodine or other remedies, until secondary involvement of lymph nodes has occurred.

Early diagnosis and radical operation with the cautery should be insisted upon.

In late cases in which the complete removal with the cautery seems impossible, radium needles should be implanted 0.5 centimeter beyond the margin, forming a circle entirely around the growth. X-ray should be applied properly to both sides of the neck and in front. As soon as the patient has recovered from the effects of this treatment, the lingual artery should be ligated, and the entire growth together with 1 centimeter of apparently healthy tissue should be removed with the cautery, and a careful excision of the lymph glands should be made with the electric cautery, the incision in the skin having been made with the knife.

Dr. Crile has covered the treatment of cancer of the jaw very fully. I have made a study of 126 cases of cancer of the jaw which I have operated upon at the Augustana Hospital. This experience has convinced me of the correctness of

the following conclusions which correspond quite closely with those contained in Dr. Crile's paper.

1. We have found that the occurrence of cancer in the jaw is usually preceded by some form of mechanical irritation, trauma, decayed roots of teeth, badly fitting plates or bridges.

2. Inflammation due to filth or infection connected with carious roots seems to precede the cancer infection.

3. The growths are characterized by slowness of invasion of surrounding tissues.

4. They also fail to produce metastases in distant organs.

5. Incomplete operations are followed by immediate recurrence and rapid increase of the growth resulting in death, regardless of future operations or of X-ray and radium treatment.

6. Insufficient radiation seems to have the same harmful effect.

7. We have obtained the best results from very thorough early operation with the cautery iron, destroying the tissues at least 1 centimeter into the apparently perfectly healthy surrounding area. We follow the rule of destroying at the primary operation with the cautery as much tissue as we would naturally expect to destroy after the first recurrence.

The lymph nodes are dissected with the fine knife of the electric cautery. In place of using the chisel and saw for removing bone we use the red hot soldering iron which carries a very intense heat to a much greater depth than the ordinary cautery.

In case it seems advisable we cauterize the bone first, then chisel away the cooked portion and reapply the soldering iron until the desired depth has been reached. A sequestrum will form which will loosen later and can be easily removed.

In all of these operations, the following technique is employed in administering anæsthesia:

Morphia, ¼ grain, and 1/150 grain of atropin are given 1½ hours before anæsthesia is begun, and ⅙ grain morphia and 1/200 grain atropin ½ hour before. Then ether is administered very slowly by the drop method with the patient in the horizontal position until the patient is very deeply anæsthetized.

The head of the table is then elevated to 90° causing anæmia of the brain which prolongs the anæsthesia so that the operation can be completed without any additional anæsthetic.

The atropin prevents the accumulation of mucus in the pharynx and the elevated position of the head together with the use of the cautery reduce hæmorrhage to a minimum.

As soon as the head of the table is lowered, the patient is awake. Since introducing this method 25 years ago, we have had no postoperative pneumonia in these cases.

By Vilray Papin Blair, St. Louis

Fifty per cent of all carcinoma of the mouth could be eliminated in the precancerous stage. Half of the remainder could be cured by relatively simple operations if treated when first seen. A certain percentage is deadly from first inception.

The great majority are squamous but basal cell; glandular and metastatic tumors do occur. Location has a bearing on both prognosis and treatment. Lip growths are the most curable while central upper jaw cancers are rarely curable by cutting operations.

Tongue cancers form the basis for the best available statistics. Whitehead reported 3 per cent operative mortality for intra-oral operations and for complicated cases over 44 per cent. In 200 cases Butlin had twenty deaths, but it was 25 per cent where the jaw bone was divided. For the latter part of the series he reported 41.5 per cent cures for 3 years or over.

The statistics of Kocher, Warren, and Loison do not equal these. Dr. Judd's series, the largest to date is remarkable for high percentage of cures and an extremely low operative mortality.

These reports substantiate my own belief that cancer of the mouth is on the average not as deadly as painted. Ordinarily it receives the most inadequate treatment. To treat it first for syphilis and then to cut it out with a half inch margin is still common practice, yet early diagnosis is easily made and on the average it responds well to early surgery. Among my private patients, mostly people who sought medical advice soon after observing the lesion, 64 per cent were very far advanced or inoperable when they first came to me, and I have done very radical operations upon about 80 per cent of this latter group, because it is difficult to pick the incurable case and any procedure that gives a fighting chance is justifiable. The other side of the picture is 100 per cent deaths in the worst form known, but very few ever metastasize below the clavicle.

It is on this advanced type that my report will be based. Including extrinsic carcinomata of the larynx, I have operated upon seventy-three far advanced carcinomata of the mouth in 8 of the past 10 years. This group is made up of combined involvements such as jaw, cheek, and neck; tongue, jaw and pharynx and floor; tongue, pharynx, and larynx; growths with fixed or broken

down neck glands, etc. A number of these were recurrent cases. No basal-cell tumors nor growths requiring simple laryngectomy nor simple amputation of the tongue or lip with gland resection are included in this series. A number had already been considered inoperable. Those that survived the first operation required from 2 to 10 operations before it was considered the greatest removal and best repair had been completed.

The operative mortality (cases dying in hospitals) was 17 cases, 23.5 per cent; 14 of them from bronchopneumonia. Some died after the third or fourth operation and 2 from repair operations. Forty of these cases were operated upon 3 or more years ago and of these eleven or 27.5 per cent were known to be alive and well 3 to 7 years later, nine to be dead of some cause and twenty untraced. More than half of the traced cases of this group were well over 3 years and none of them are known to have since died of carcinoma. Of the cases operated less than 3 years (thirty-three in all), five are known to be well 2.5 years after operation and two alive 2 years and five for over 1 year. The death rate, over 23 per cent, is much too high. Most of these deaths occurred in the unsettled post war period and later reflection convinces me that half the bronchopneumonias should have been prevented. He who heeds Billroth's caution not to suture the floor of the mouth, will seldom see a severe sepsis or a secondary hæmorrhage after a cutting operation, but he who uses the soldering iron on the soft tissues is courting secondary hæmorrhage.

All our well established cases of tongue cancer are by choice operated upon by the suprahyoid approach by which the whole tongue, floor of the mouth, submaxillary and submental glands, parts of fauces, palate or pharynx can be removed in one mass. This gives a higher death rate than the simple intra-oral hemisection but permits of a much wider excision, and strange as it may seem the speech results are better than after the hemisection. There is one physician on whom 7 years ago I removed his whole tongue from the hyoid for a recurrent carcinoma and he has ever since attended his practice and has a speech that is just a little "thick."

Besides ignorance or selfish motives that might actuate a few, the two chief causes that account for failure to make an early diagnosis are: first, a sentimental attitude that leads the physician to regard the lesion as non-malignant until it is proved cancer; second, a misinterpretation of the report of the microscopic findings. If the first consultant would regard every wart, every superficial induration, and every persistent fissure or ulcer as cancer until proved otherwise and would regard with very grave suspicion every negative microscopic diagnosis, or diagnosis of "inflammatory tissue," then the whole chapter of cancer of the mouth could be rewritten in a very much more cheerful tone. Even worse than a failure of diagnosis is the treatment with irritants, insufficient radiation, or inefficient operation. Cancer is best handled as one would treat a skunk—let it alone or kill it quick, only grief can come from irritating it. In planning treatment or forming a prognosis, the age and size of the tumor and the tissues involved should not form the sole basis of judgment. Some of the larger tumors are fenced around by, and composed largely of, inflammatory tissue that long retards gland infection; while some of the small shallow ulcers that look like abrasions of the mucosa are often the most deadly. Except in the upper jaw the primary growth does not early erode the bone, but the secondary growth in a lymph node, usually the buccal gland, will walk through the mandible like a smudge fire in a rotten log. In regard to time, certain growths were beyond help 2 months after they were first noticed while others seemed easily operable 18 months after they first gave symptoms. Recurrent pain radiating to the ear and vertex and the unexplained enlarged node in the adult should always be regarded with cancer suspicion. The primary lesion is not always easy to find. In one of my cases an immense carcinomatous mass in the neck was dependent upon a slight roughness of the uvula that was detected with the finger but hardly visible. Pharyngeal growths often go undetected. In another case a small ulcer on the anterior surface of the epiglottis remained undiscovered for 4 months after it was persistently sought. All associated lymph-bearing areas should be removed in every case. I have seen gland infection become manifest 8 years after cure of primary lip ulcer and a spontaneously cured lip ulcer followed 4 years later by a squamous epithelial infection of a corresponding lymph node.

Within the mouth I use hot cutting cautery, in the neck knife and scissor dissection. Only on bone do I use the soldering iron, and except to make a false joint after cauterizing the pharynx, I no longer resect the jaw for carcinoma.

We have had some remarkable immediate results from radiation and as soon as X-ray or radium is proved to cure cancer of the mouth, I will abandon mutilating operations, but if before that time I should be so unfortunate as to develop one on myself I will seek the man who does the most radical operation.

By DOUGLAS QUICK, M.B., (Tor.) New York

At the Memorial Hospital, our methods of treatment of the diseases under discussion are at present almost diametrically opposed to those already advanced. These methods are the result of gradual study, observation of radium effects, and consequent change of viewpoint during the past 7 or 8 years, until we now give radium, rather than surgery, first place in treatment of the primary lesion and have adopted a conservative rather than radical procedure in dealing with the cervical nodes. While our period of observation is still too brief to make statistics of real value or comparable to surgical statistics, nevertheless, from the gradual accumulation of evidence, we feel justified in our present stand.

We began using radium in the primary growth in hopeless, inoperable cases: as technique improved and experience accumulated, we were able to demonstrate its value sufficiently to warrant using the same methods in operable cases. The results improved just as do surgical results in selecting cases. At present we use radium entirely in the treatment of the primary lesion in the groups under discussion, with two exceptions—in lower jaw cases with secondary bone invasion and in carcinoma of the maxillary antrum with limited or no bone invasion, we advocate a combination of radium and surgery. We feel that our present position is due almost entirely to a radical change in technique made early in 1916. Previous to this period we were using surface applications of filtered radium in various combinations with some results from a palliative standpoint but very little encouragement as far as complete regression of growth was concerned. It was then that the late Dr. H. H. Janeway advanced the method of burying radium emanation directly into tumor tissue and leaving it *in situ*. This method has practically revolutionized all of our radium work. I believe the method is even yet but little understood outside the circle of a few roentgenologists, hence a word of explanation may be in order. Radium element gives off a gas or emanation which is constantly being redeposited on the walls of its container in the form of solids of rapid change, and it is from one of these, radium C, that the radiations of therapeutic value are given. It is possible to separate this radium emanation from the element itself and place it in any type of container desired. This emanation decreases in strength at a fixed rate—approximately 15 per cent per day. It is evident that the total dosage or energy from a given amount of emanation can be calculated once it has been measured against a known radium standard. It is also evident that for practical purposes this emanation will exhaust itself inside of a month. We have taken advantage of these facts and in our physical laboratory prepare fine, thin-walled, capillary glass tubes approximately 3 millimeters by 0.3 millimeters in size, containing radium emanation. These are buried uniformly throughout the growth by means of trocar needles, and left *in situ*.

The advantages of this method are, uniformity of dosage, accuracy and intimacy of application, and utilization of β as well as γ radiation. It affords a very prolonged radiation permitting of greater dosage and is of further value if we concede that the neoplastic cell is more vulnerable at the time of division. We have had practically no trouble from the small glass tube as a foreign body.

This method of burying radium emanation we use almost exclusively in the treatment of carcinoma of the tongue, cheek, and jaws, supplemented in certain cases by external or surface applications of filtered radium. We use it also in the lip for some of the deeply infiltrating growths, but for most part the lip lends itself admirably to external radiation. If proper molds of the lip are made with dental modeling compound, it is possible to make accurate applications to three sides of the lesion. I cannot agree with Dr. Brewer that surgery is preferable to radium in the lip. I believe that with radium, just as with surgery, it is one of our most brilliant groups. Unfortunately, our statistics which Dr. Brewer has referred to, were taken from the earlier advanced cases treated by methods decidedly inferior to those employed at present. I believe that our rather good results in cheek cancer have been due to the fact that we have been able to treat from both sides, that is, emanation buried directly into the growth and heavily filtered radium applied over the cheek, outside, in close proximity to the base of the growth.

Our conservatism in the treatment of cervical nodes is based primarily on two suppositions which are strongly supported by our clinical observations: first, that cervical lymphatics perform a conservative function, which is much more than that of a filter, up to a certain point; and second, that extension of disease to the nodes is embolic. In support of the first supposition we have adequate microscopic evidence of encapsulation of tumor cells by new connective tissue and destruction by active lymphatic infiltration—and we have all seen the rapid recurrences with increased rate of growth once these factors of natural immunity are interfered with. In support of

the second premise we have the conclusions of many workers who have been unable to trace direct extension along the lymphatics from the primary growth to the nearest nodes and the clinical observation that nodal involvement does not occur in sequence. In my own experience I have found the jugular node, at the junction of the submaxillary and upper deep cervical lymph chains, involved much more frequently than any other.

On this basis we decided to leave the neck alone unless a node was palpable or until one became palpable. We then did a unilateral block dissection of the involved side: this was in the earlier part of our work. Our next step was to insert filtered radium in rubber tubing in the wound much as a drainage tube is placed. When we began using radium emanation tubes interstitially we made use of them in our neck work by burying them at any suspicious points in the surgical field and especially at the points where the lymphatic chains were severed. Our results, relative to early recurrences, were noticeably improved. The next step was to select certain cases in which the disease had extended beyond the capsule of the node and in which surgical operability was questionable. In these cases the nodes were exposed surgically, emanation buried uniformly throughout the involved area, and the wound closed. We now have a small group of these interesting cases clinically free from disease beyond the 3 year period. For the past 3 years we have made it a routine procedure to radiate all necks externally either with filtered radium or X-ray, whether nodes were palpably involved or not, and no neck is operated upon, either for removal of nodes or insertion of radium emanation tubes, without preliminary external radiation.

In referring to our statistics I must admit frankly that they are not of sufficient duration to carry much weight. I shall not include any of our recent cases, but will confine my report to the 5 year period—1916 to 1920, inclusive. I must also call attention to the fact that these results have been obtained in an unselected group of cases, most of them well advanced, few surgically operable and many of them hopeless from any standpoint. Our technique in treating these cases was in great part crude and the results do not represent what we feel we can now accomplish.

In the lip group 162 cases were treated and of 115 which we were able to trace 80 were free from disease for an average period of 18 months; of 22 neck dissections done 15 were free from disease for an average period of 18 months.

Of 148 cases of cancer of the tongue, 27 per cent were classed as surgically operable. Of the whole series of 148 cases, 43, or 29 per cent, were clinically free from disease in December, 1920, for an average period of 2 years. In 58 cases neck dissections, plus radiation, were done and 43 were free from disease at that time.

In the lower jaw group we had 69 cases with 13 clinically free from disease for an average period of 2 years, and 14 still improving.

The superior maxillary lesions we have divided into two groups: those beginning in the mucosa over the alveolar ridge and those beginning in the antrum. In the former group we had 44 cases, with 9 free from disease for an average period of 25 months and 5 still improving. Of those arising in the antrum we had 36 cases in all with 8 free from disease for an average period of 27 months and 5 still improving.

We had 44 cases of carcinoma of the mucosa of the cheek with 11 free from disease for an average period of 27 months and 5 still improving.

These statistics were all taken from my radium report made December 31, 1920, and time has not permitted bringing them all accurately up to date. However, in the 21 months which have since elapsed, there has been a marked improvement. This is evident from Dr. Brewer's quotation of our mucosa of the cheek statistics, which give us now 35 per cent clinically free from disease for the 3-year period as against my 25 per cent for a 27-month average period. It is a well established fact that most recurrences are evident during the first year following any method of treatment.

In a general comparison of our results just quoted we have had fewer recurrences in the intervening 21 months from using radium alone on the primary lesion and a combination of radium and surgery in the neck than has been the experience from surgery alone, notwithstanding the fact that we were dealing with an unselected group of cases.

By GEORGE P. MULLER, M.D., Philadelphia

Before we can intelligently determine the proper method of treatment to be pursued in a cancer of the lip, tongue, or mouth we must clearly understand that there are three areas of disease, viz.: (a) the local or primary focus; (b) the paths of permeation and lymphatic radiation and, (c) the temporary depot-like action of the lymph nodes. We must also appreciate that the primary lesion varies in its degree of malignancy as has been well shown by Brœders in his paper published in 1920 in which he grades cancer of the

lip according to the percentage of differentiated and undifferentiated epithelium.

Roughly speaking we must remember that, in cancer of the tongue and floor of the mouth and in cancer of the lip except at the corners, the lymphatic drain trunks overlap to such an extent as to make bilateral metastasis inevitable sooner or later. Furthermore, epithelioma from the mouth tends to remain in the group of lymph nodes receiving the direct drainage for a considerable period of time before invading other groups. And finally, most of these patients die from hæmorrhage, or infection, or from mal-nutrition due to inability to masticate or difficulty in swallowing.

We hear much these days of the failure of surgery to cure these unfortunate people, and I suppose that in the case of the tongue and jaw groups the accusation is a just one, because published statistics usually show a record of cure in only about 15 per cent. On the other hand cancer of the lip, if operated on early, shows a record of cure varying from 70 to 90 per cent. The advanced state of the lesion and the failure of the surgeons to carry out a sufficiently radical excision have no doubt been factors largely responsible for the poor results. The extended use of local anæsthesia and the support given by repeated blood transfusions have eliminated largely the high mortality formerly attendant on very radical surgery of the tongue and mouth.

I would strongly commend to the opponents of surgery certain statements contained in the paper by Frances Carter Wood.[1] We are all interested primarily in the welfare of the cancerous patient and want to offer him that method, be it what it may, which offers the best prospect of a permanent cure. To some extent the patient himself is helping to solve the problem, whether to his weal or his woe, because it is our experience in Philadelphia that cancer of the mouth is now only rarely seen in the surgical clinics except where ligations, biopsies, or measures for the relief of pain are desired by the radiologists. The patients themselves clamor for radium, never for operation.

It seems to me that the patient and the family physician should understand that the suffering and often the mutilation from the use of radium and electrocoagulation is more severe and more extensive than that which follows operation *per se*.

Recently I sent a questionnaire to twenty-five surgeons and seven radiologists in my city and of these twenty-four replied. Only three believe that surgery should be abandoned in the treatment of cancer of the lip. Generally, we practice excision of the lip or tongue cancer when it is early and perform a block dissection of one or both sides of the neck according to the standard surgical technique. All follow up the operation with X-ray treatment. In the case of the upper jaw, most of us prefer to use the cautery during the removal of the jaw. The important point is made by both the radiologists and the surgeons that advanced cases are hopeless and incurable by any method and should be left alone, except in so far as treatment is demanded for relief of pain. We believe that the results of surgical treatment, meaning excision with the knife and block dissection, of cancer of the lip, are every bit as good as those obtained by radiological methods, but I think I interpret the opinion of the majority when I state that the results of surgery in the treatment of cancer of the tongue and jaw are poor. One explanation offered is that the lymphatic drain is so deep in the neck, so far back under the tongue, that surgical removal is not possible.

The radiologists are cautious in making claims but one at least has published his opinion that in cancer of the lip electrocoagulation, radium, and X-rays are much superior to surgical treatment, and I believe that in a short time they will all openly make this statement not only in the case of the lip but also in the case of the tongue, cheek, and perhaps all other cancers. The following statement by Pancoast is a fair one: "If surgical and non-surgical measures offer equally good results in any group of cases, but if one gives better results either as to cures or palliation it should be regarded as the method of choice. Thorough non-surgical technique is every bit as essential as thorough surgical technique."

Wood states regarding operation and radiation: "Each has its rightful place in the treatment of cancer, and by an intelligent combination of operation with radiation better results in the treatment of neoplasms will undoubtedly be obtained in the near future. But at the present moment we are still far from having any very effective control over the cancer situation." I notice in the replies to my questionnaire, that most of us draw a distinction between "early" and "late" cases and all relegate the latter to the radiologist. Now if radium and X-ray, properly used, are superior to excision they should supersede it; if inferior, why subject these patients with advanced lesions to the expense and suffering entailed by radium applications? As for electrocoagulation I fail to see that it offers anything over the ordinary cautery except in cancer far back in the mouth, and I would welcome the opportunity to check up the end results of many

of the case reports from Philadelphia. It is proper to remark that in hospitals where no radium and rather limited X-ray facilities are available, the surgeons are mostly committed to operative treatment.

At the present time, influenced to a great extent by the work of Pancoast, I believe that cancer of the lip and mouth should be treated by a combination of X-ray, radium, and operative surgery. The primary lesion should be treated by surface radium radiation and later destruction by the knife or cautery in the case of the lip, or by bare radiation emanation tubes, cautery, or electrocoagulation in the case of the tongue or mouth. At the appropriate time a complete block dissection of the neck should be performed in the case of carcinoma of the tongue, and a partial excision in the case of carcinoma of the lip. If it is intended to use electrocoagulation in the treatment of the primary lesion, this may be done at the time of the dissection in order to allow of the ligation of the blood supply. I do not ligate the external carotid, believing that the danger of hæmorrhage from cutting by the ligature is great, but prefer to ligate the lingual, facial, and internal maxillary branches. After the neck is healed, postoperative radiation should follow and be continued on the slightest evidence of recurrence. At the time of the block dissection of the neck, it is best to practice radium implantation at the well known areas of frequent recurrence. I do not use the knife on the primary focus except in the case of small, early lesions of the lip, and it may be that I will some time abandon operative measures entirely and advise all of my patients to have radium or X-ray treatment only, of the lymphatic areas in the neck, but so far I have not been convinced that such measures can take care of the growth.

The common practice of some radiologists in reporting cures 8 or 10 months after treatment, with pictures of the patient before and after, cannot be too strongly condemned. No operating surgeon considers such cases cured for at least 3 years and usually 5 years from the time of operation, and the same rule should be followed by the radiologist. I would commend to all of them the excellent "form" used by Greenough of Boston.

By CHANNING C. SIMMONS, M.D., Boston

As a basis for the following remarks I have reviewed the 651 cases of cancer of the buccal mucosa observed at the Collis P. Huntington Memorial Hospital during the past 5 years and analyzed the 186 cases of cancer of the tongue seen in the 3 year period, 1918 to 1920 inclusive.

The hospital was founded for the study of cancer and is the only institution in this community that has any large quantity of radium which is employed for treatment in the form of emanation. Most of the cases seen are of the advanced type or hopeless postoperative recurrences but we are now beginning to see more early cases in consultation. The policy is to consider that all cases are seen in consultation with their physician and treatment advised — not necessarily radium if it is not considered indicated.

The outstanding feature in the histories of these cases was the relation of chronic irritation to the disease as a predisposing cause. Bad teeth, either poorly cared for, or decayed were almost universal. The majority of the patients smoked while some chewed. Two cases occurred in men who were in the habit of holding nails in the mouth. Leucoplakia was common but the Wassermann was positive in only 14 per cent of the cases.

Cancer of the buccal mucosa is a rapidly growing form of the disease, and the cases are often hopeless as regards cure within 2 months from the onset. The average delay on the part of the patient from the onset of symptoms to the first consultation with a physician was 1.9 months, and 72 (39.8 per cent) are definitely known to have received poor advice from the first physician or dentist consulted, the dentists being the worst offenders.

Pathologically three types are seen. The common form is the rapidly growing squamous cell cancer which forms metastases early, although rarely below the clavicle. A papillary form of squamous cell cancer is seen which is of much slower growth and forms metastases late. A basal cell type of cancer is rarely seen.

We have practically come to consider any ulcer of the tongue as cancer until proved otherwise. Complete excision with cautery of small ulcers of the tongue, which do not disappear promptly on removing a possible cause, is a simple matter and the results are uniformly good. If cancer is not present we have at least removed a precancerous lesion. A few cases of tuberculosis of the tongue, a condition closely resembling cancer, are seen at the clinic every year. These ulcers are almost always painful and usually secondary to tuberculosis elsewhere in the respiratory tract. Excision is the proper procedure. If a patient has a suspicious growth on the tongue and a positive Wassermann, appropriate antisyphilitic treatment is given but the tongue lesion is treated as

malignant since the two diseases may exist together in the tongue and much time may be lost waiting to observe the therapeutic effect of the treatment. In all cases of leucoplakia the mouth should be kept free from irritation. The teeth should be cared for, tobacco in any form prohibited, and the patient kept under observation as these cases are very apt to develop cancer.

TREATMENT

We have been disappointed in the results obtained by the use of radium as a curative agent and do not advise its use in early cases. Of 21 cases of what might be termed early cancer treated with radium, two are living without evidence of disease over three years. In one the growth was small and of the papillary type. The second case was a small post-operative recurrence and it was necessary to keep the patient under morphine for six weeks on account of pain due to the radium reaction. I feel that the same results could have been obtained in a shorter time with the cautery with much less pain and discomfort.

In palliative treatment, radium is a very useful agent. It is usually employed as "seeds," that is glass tubes 1 by 2 millimeters in diameter containing from 1 to 5 millicuries of radium emanation. The seed is introduced into the center of the growth by means of a hollow needle, where it remains, and from each seed of 1 millicurie strength introduced the patient receives 132 millicurie hours treatment before the emanation disintegrates. The results of treatment by this method are much better than by the application of the radium to the surface of the growth. In 85 per cent of the cases treated by the seed implantation method the rapidity of the growth was delayed and the patient's life obviously prolonged. Of the cases treated by the application of radium in a container to the surface of the growth 54 per cent showed improvement.

In all cases in which there is a possibility of cure, we are advising radical operation done in two stages. The local growth is removed with the knife and cautery and ten days later a radical unilateral neck dissection is done. By radical dissection I mean removal of the internal jugular vein, the sternomastoid muscle and all lymphadenoid tissue from the clavicle to the base of the tongue. A partial dissection may not remove all the disease and by disseminating the cells hastens the fatal outcome. If the growth is in the midline, bilateral neck dissection is advised. For cautery I have been in the habit of using jeweler's soldering irons and find them more satisfactory than the cautery knife.

Our routine method of treatment may be summarized as follows:

1. Very early or precancerous cases — intrabuccal local excision of the growth with cauterization of the wound.

2. Early cases without fixation — excision of the local growth and cauterization, and ten days later radical neck dissection followed by post-operative X-ray treatment.

3. *a*, Early cases in which the condition of the patient does not warrant the radical operation; *b*, cases of the papillary type; *c*, advanced cases in which the chance for permanent cure is remote but in which the local growth may be entirely removed — excision of the local growth by the knife and cautery and X-ray treatment to the glandular areas of the neck. This operation can be done with little shock and under local anæsthesia in many instances. In studying the records I find that of 18 cases in this group which were operated upon more than 2 years ago, nine are living at the present time and they without evidence of disease.

4. *a*, Cases in which the local growth cannot be entirely removed; *b*, cases with definite metastatic glands; *c*, recurrent cases — radium treatment by the seed insertion method of the growth in the mouth and X-ray treatment of the glands in the neck.

Lip. We believe that operation is the treatment of choice in practically all cases of carcinoma of the lip and do not employ radium. The local growth can be removed surgically, under local anæsthesia if necessary, more quickly and with less discomfort to the patient than by radium. We advise removal of the glands from one or both sides of the neck, depending on the location of the tumor, in every case. We do not advise the radical complete neck dissection as in tongue cases but are content to remove, in one piece, the glands in the submental and submaxillary spaces, and carry the dissection to the bifurcation of the carotid.

I believe that lower mortality from cancer of the buccal mucosa and better operative results will come more from the early recognition of the disease and prompt adequate treatment than from any improvement in our methods.

POLYCYSTIC KIDNEY

By R. H. CRAWFORD, B.S., M.D., F.A.C.S., Rutherfordton, North Carolina
Rutherford Hospital

MY interest and concern in the condition of polycystic kidney was aroused anew when there appeared at the Rutherford Hospital last fall a strong, healthy looking young man complaining of "blood in his urine and a fullness in his abdomen." While obtaining the family history the writer was amazed at the frequency in which the condition had occurred in various members of the patient's family.

Examination showed a robust young man, 34 years of age, a dentist by profession. He stated that for a number of years he was conscious of the fact that he had an abdominal tumor which increased slowly in size and that at varying intervals he noticed blood in his urine. The abdomen was markedly distended by a huge mass extending well down into the loins on the two sides—almost the entire abdomen was filled with the hard, firm tumor formation. By careful palpation one could distinguish two tumor masses practically meeting in the mid-line of the abdomen. The surface of the tumors was irregular, nodular, but compressible. It appeared certain to the writer that he was dealing with a large bilateral kidney tumor—the exact nature of which could not be determined at preliminary examination. Bilateral polycystic kidney was suspected and a painstaking family history was obtained. The patient stated that a number of his brothers and sisters were affected with the same condition and he would have them come in for examination. With the aid of several members of the patient's family, a complete history was obtained extending back for four generations. The origin of the family in America dates back to the time when four brothers from England emigrated to this country. One brother—B. N.—married and had six children. The four brothers lived to be old men and the causative factor of their deaths is unknown. One of the six children, a son, John N., married and was the father of twelve children. He died supposedly of "alcoholism" but lived to an old age as did his brothers and sisters. One of the twelve children—Ben N.—died at 77 years of age, apparently from an abdominal tumor. A sister died of dropsy; a brother was killed in the Civil War; another brother was drowned, while the cause of death in the others is unknown. Ben N. (mentioned above) is the first member of the family in which the condition of cystic kidney presents itself so far as known. He married and had seven children. One, a daughter Sara, was explored and a diagnosis of polycystic kidney confirmed; she is living at 74 years of age. Three children of the seven died in uræmia following polycystic kidney. Each of the four with polycystic kidney married and the same condition appeared in their offspring in one or more instances and in the grandchildren in two cases. One of the four, J. N., married and had nine children. His wife, the mother of my patient, is living and well at 60. J. N. was examined at the Rutherford Hospital in 1916 and a diagnosis of polycystic kidney made. He has since died. Eight of the nine children are living, one died at 13 with typhoid fever. The eldest is 43 and the youngest 20. Seven of these have been examined by the writer and six have easily palpable kidney tumors. The youngest apparently has no kidney involvement. D. N., age 38, was explored in 1916, and a diagnosis of polycystic kidney confirmed.

O. N. had a nephrectomy, left, performed in 1910, and at the present time there is a large tumor mass of the right kidney.

E. N. has a huge bilateral enlargement of the kidney. She was operated in 1915, and the cysts were opened and drained. Out of a family of nine children, seven have easily palpable kidney tumors. In three of the cases the tumors can be readily detected through the clothing.

The urinary findings in my patient, A. N., admitted to the hospital, revealed a few red blood cells, numerous white blood cells, and a good trace of albumin. A diagnosis of bilateral polycystic kidney was made. The patient was very anxious that something be done to relieve the sense of fullness and discomfort in his abdomen and the hæmaturia which interfered with his usual efficiency. Following the technique of Hagner, an exploratory incision and puncture of the cysts was advised and accepted. Under novocaine anæsthesia, a left rectus incision was made over the larger of the two masses. Two huge polycystic kidney tumors were found practically meeting in the mid-line of the abdomen and extending well down into the groin on the two sides. The cysts varied in size from a marble to an orange. A large cyst in the left kidney tumor was aspirated, and the fluid content was of a clear amber color. The incision healed *per primam*, but patient became weaker after operation and 2 weeks after return home died of uræmia.

In 1902, Osler recorded the fact that the condition occurred repeatedly in a family under his observation. Borelius,[1] of Stockholm, describes three cases in the same fam-

[1] Nord. med. Ark.

HISTORY OF A FAMILY OF NORTH CAROLINA WITH REFERENCE TO POLYCYSTIC KIDNEY

ily: father, son, and nephew. He believes that all cases are hereditary. J. K. Love and Richmond report two cystic kidneys removed post mortem from a patient in whose family this peculiarity had repeatedly occurred. Flintermann describes the same condition in two sisters confirmed by autopsy findings.

The condition is comparatively rare. Preitz's records of Kiel Institute found among 10,000 autopsies only 16 cases. Garceau found 10 cases in 2,429 autopsy records of the Boston City Hospital. Sieber,[1] in a series of 198 collected cases, found 116 females and 82 males. The majority of these cases occurred between ages of 40 and 60.

Luzzato.[2] in 226 cases, found that 185 were bilateral. Sieber, in his report of 150 autopsy records, found that 140 were bilateral, that the disease is nearly always bilateral is well illustrated by its almost invariable recurrence in the opposite kidney after nephrectomy. Sieber noted in 39 cases of his series that cysts of the liver accompanied cystic kidneys.

Numerous theories have been advocated as to the pathogenesis of the condition. I shall mention three well known theories: (1) embryonic, (2) new-growth, (3) inflammatory.

1. Huber[3] states that in embryonic development, a perfect union of the tubules has failed. The idea advocated by Shattuck and Bland-Sutton is in brief essentially that the wolffian bodies and the kidneys which in normal circumstances are distinct become blended and through this failure of differentiation an abnormal kidney results with cystic formation. In fœtal and infant cases numerous malformations occur accompanying the cystic kidneys such as hare-lip, supernumerary fingers or toes, club feet, etc.

2. The theory that they are true new-growths strongly supported by C. Nauwerck and K. Hufschmid[4] is not held today. Malassoz first conceived the theory of new-growth, but Brigidi and Severi believed that the cyst contents were nothing more than the protoplasm of the epithelial cells fused together. They thought they could observe nuclear division of the cells and compared the affection to ovarian cystoma.

3. Virchow believed that the cysts were true retention cysts and that they resulted from occlusion of the urinary tubules in consequence of inflammation of the interstitial tissue in the papillæ of the kidney, a view now entirely abandoned.

[illegible]

[illegible]

[3] Huber, G. C. Am. J. Anat., 1904-5, IV. 17.

[4] Nauwerck and Hufschmid. Beitr. z. path. Anat. u. z. allg. Path., 1893, XII, 19.

SYMPTOMS

It is passing strange that many of these cases may go to the third or fourth decade without appreciable symptoms. Their attention may first be arrested by fullness and hardness in the abdomen. Others feel a sense of weight in the loins and complain of pain of varying character, perhaps renal colic at intervals. Hæmaturia occurs at irregular intervals and may clear up in a few days' time or less, only to start again at a later date. The hæmaturia is probably caused by rupture of a cyst with bloody serum. A disturbing symptom is frequent urination with a total output for 24 hours larger than normal. In the later stages, there are constitutional disturbances due to nephritis followed by gastric disorders and loss of weight. Usually there is secondary cardiac hypertrophy along with arteriosclerosis. A severe anæmia may intervene, and with generally failing health the patient becomes progressively worse and dies of uræmia.

DIAGNOSIS

Tumor formation is present in one or both flanks having contour of kidney. If both kidneys are involved polycystic kidney is almost certain as this is practically the only tumor of the kidney regularly of bilateral character. The tumors may obtain large size without any symptom. The tumors appear to grow anteroposteriorly but are irregular and nodular. The tumors extend well down into the flank on the two sides and may meet in the mid-line of the abdomen. The urinary findings may be negative but often contain red blood cells, white blood cells, and albumin.

Differentiation between hydronephrosis, pyonephrosis, and hypernephroma can usu-

ally be made by ureteral catheterization. Functional tests of the kidney are helpful to determine the amount of tissue destruction in the kidneys, etc. The cysts are packed closely together and invade every portion of the kidney substance. The walls of the cysts are usually very thin and inside of them are sometimes seen the remains of septa which mark the places of coalescence of neighboring cysts. The fluid content appears in a variety of colors.

PROGNOSIS

The patients are poor operative risks if any such procedure is contemplated. Hagner, Lund, and Rovsing report a series of cases in which the cysts were punctured and drained. The size of the tumors was decreased and patients made more comfortable temporarily. Nephrectomy has been performed many times when the remaining kidney appeared normal—but invariably a few years later the remaining kidney would become cystic also.

Many patients live to a ripe old age without treatment—the majority, however, die about the fourth decade.

SUMMARY

Polycystic kidney is congenital and practically always bilateral. Cysts of the liver may accompany the condition. In fœtal and infant life hare-lip, supernumerary fingers or toes, club feet, etc., may be present along with cystic kidneys.

Heredity plays an important rôle and from my series of cases I venture the opinion that it is a familial affection.

Surgical interference may be adopted—the cysts opened and drained with temporary relief to the patient. Nephrectomy is not indicated even though one kidney appears normal, because the remaining kidney almost invariably becomes cystic.

The patients are poor operative risks. The majority of them live to the third or fourth decade and many have no symptoms other than a sense of fullness and hardness in the abdomen. The tumors are slowly growing formations and are rarely seen between infancy and 18 years of age.

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LEUCOPLAKIA OF THE RENAL PELVIS

By R. F. CUMMING, M.D., Detroit, Michigan

THE leucoplakial conditions of the urinary tract have received relatively little attention in America prior to 1920. During that year, two excellent articles appeared. Kretschmer (1) reporting a case of bladder and ureter involvement, gives also an admirable résumé of all the literature bearing upon the subject. Richey (2) reported leucoplakia in the pelvis of a kidney removed for another condition.

Earlier authors are inclined to consider leucoplakia more frequent than is commonly thought; scarcity of case records certainly indicates an extreme rarity. Kretschmer collected 44 cases, after a careful search of all available literature. He added his own case. With Richey's case and that of our own there are 46 reported cases. The latter named author states that Rokitanski, Orth, and Pollack have also reported leucoplakia, making a possible total of 49 cases.

It should be recalled that the buccal mucous membranes, including the tongue and the œsophagus commonly show the pathology, with an almost undeniable relation to syphilis, alcoholism, and irritation from smoking. Leucoplakia is much more common in the bladder than in the kidney pelvis; the ureter has not been heretofore considered singly as a locus. Of the 49 cases referred to the sites were: bladder, 27; ureter, 5; pelvis, 15; mixed, 7; and undetermined, 3. Of the mixed cases, the kidney and ureter were more often involved together. The smaller number of reported renal pelvis involvements may be based upon the assumption that the bladder diagnoses were made usually *in vivo* by means of cystoscopic examinations, while the kidneys and ureters were recognized as guilty at operation or necropsy with only a few exceptions.

While the contention that leucoplakia is not so rare as generally assumed, is a sound one, we are forced to consider the fact that routine autopsies are becoming the order of the day even in America, and that universally the kidneys are removed for examination whether a complete postmortem study is made or only suspected parts secured. Many writers, prolific on other urological entities and having vast diagnostic and surgical experiences, dismiss leucoplakia with the statement that it is very rare as urinary tract pathology. Keyes (7) states that he has not seen the condition in the renal pelvis.

The abridged case history following will invite a later discussion:

Mr. C. S., age 28, white, a discharged soldier, was admitted to Walter Reed Hospital October 19, 1920. The family and previous personal data are unimportant. The patient denied venereal disease. He had formerly used whiskey moderately and was an inveterate cigarette smoker. His complaints were: (a) pain in perineum, (b) inability to retain urine, (c) blood and pus in urine, (d) painful micturition, and (e) stiffness of neck.

Onset and course leading up to present hospital admission. In February, 1919, while on duty in France, he went on sick report with rheumatism involving neck muscles, left hand, left ankle, and both knees. As the acute symptoms subsided, a stiffness of the neck became apparent, also stiffness of the left hand and the left ankle. At this time the bladder symptoms began, notably frequent burning urination, with severe urgency. A little later blood and pus appeared and at no time since has the urine been clear. He was evacuated from France and after a few weeks in hospitals on this side was discharged unimproved, at his own request. At home, finding himself unable to work on account of the bladder disability, he reported to the Bureau of War Risk Insurance, and was sent to a hospital in West Virginia. At this time he suffered a great deal with pain in the perineum, constant aching pain, with occasional attacks of sharp stabs radiating to penis and left testicle. A suprapubic cystotomy was performed and a stone, about 4 centimeters in diameter, was removed from the bladder. He then improved somewhat, although the bladder symptoms recurred as soon as the wound healed. After more than a year's sojourn in this hospital, he was transferred to the Walter Reed Hospital.

Physical examination. The patient was a small man, fairly well-nourished. Weight 138 pounds normal 150 pounds. Eyes, ears, nose, and mouth were negative. (Later detailed examination failed to incriminate teeth or tonsils.) There was a tonic spasm of the sternocleidomastoideus and upper fibers of the trapezius on the right side; the former muscle stood out prominently, and appeared hyper-

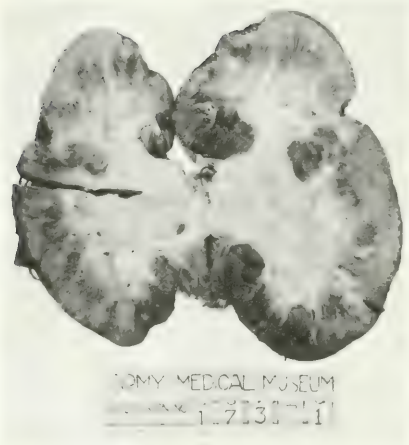

Fig. 1. Photograph of gross specimen split so as to show cavern of thickened pelvis. Note also thickening of calyces with typical "scrotal" wrinkling; the contractions of the surface with total loss of cortex in such areas; the deformed arrangement of the pyramids; the area from which blocks were made for section.

trophied, while its fellow was atrophic. The head was rotated to the right with chin up. No tenderness was found in neck muscles; no facial asymmetry. Chest was large, square type; lungs clear. The vascular system was negative. Both epitroclear glands were palpable as were the inguinal glands. There was limitation of motion in the ring finger of the left hand and tenderness in the left ankle. Abdominal examination was negative except for suprapubic scar.

Genito-urinary system: The suprapubic scar evidenced quick healing, was not tender. The prepuce was long but free, the meatus quite small. Prostate symmetrically enlarged, nodular and boggy, distinctly tender, seminal vesicles not palpable. No pain or tenderness was elicited in the perineum along the course of the ureters or over the renal fossæ. Urine October 20, 1920, was pale, cloudy, with albumin and pus, specific gravity 1010, no bacteria.

Wassermann test, October 20, 1920, was negative. Blood count, October 20, 1920: red corpuscles, 4,200,000; white corpuscles, 13,000; hæmoglobin, 70 per cent; polymorphonuclears, 82 per cent.

For 20 days the patient was kept in a medical ward for observation. Further urinalyses showed positive occult blood tests, with microscopic findings of many pus cells and squamous epithelial cells. On November 8, 1920, he was referred to the urological section and accepted for treatment. Further investigation included:

Roentgen-ray examination made by Capt. M. C. Sosman who reported negative fluoroscopic and plate findings for the genito-urinary tract.

Cystoscopy, November 19, 1920. Bladder capacity 100 cubic centimeters. Mucosa showed general chronic cystitis, with a large ulcerated area involving mid-portion of trigone and including the region surrounding the left ureteral orifice. There was no evidence of growth, calculus, or diverticulum. The ulcerated area bled freely upon the least manipulation. The right ureteral orifice was freely patent and admitted a catheter readily. The urine obtained was clear. The left orifice was difficult to find and did not admit a catheter of any size. The patient was very nervous on the table, and complained bitterly of more than 50 cubic centimeter distention. A second cystoscopy was performed November 26, 1920. At this time the left ureter was catheterized a short distance and a specimen of bloody urine obtained. A differential function study demonstrated no immediate or remote excretion from the left kidney while the dye appeared promptly and in abundance from the right. Ureteral specimens: Right—clear, practically no sediment, negative to smear and culture. Left—bloody; sediment contained many leucocytes as well as blood, but no epithelium, bacteria, crystals, or casts. Cultures were also negative. Animal inoculation tests were made with separate urines, but the animals died within too short a period to be of value. No tuberculosis was demonstrated.

Examination of urine for tubercle bacilli. Thirteen consecutive 24-hour urine specimens were examined with negative results. At no examination were other bacteria demonstrated in any considerable numbers. Squamous epithelium persisted along with pus cells and occasionally blood. Cultural reports were all negative.

Gross phenolsulphonephthalein output as tested December 3, 1920, was: first hour and 10 minutes, 25 per cent; second hour, 12½ per cent; total function, 37½ per cent.

During this period use of weak silver nitrate solution and of argyrol indicated a marked bladder intolerance for these solutions. The average daily output of urine was 1680 cubic centimeters. In spite of the failure to demonstrate the bacillus of Koch, a diagnosis of left renal tuberculosis was recorded.

Operation, nephrectomy, December 7, 1920. Gas-oxygen anæsthesia. The left kidney and upper ureter were exposed through a lumbar incision. The perirenal fat was replaced largely by fibrosis, evidencing old cortical or paranephric infection. Some difficulty was experienced freeing the kidney and later separating the pelvis from the vascular pedicle. The surface of the kidney was mottled and irregular, the capsule stripped off with difficulty leaving the kidney of an uneven color. The pelvis was firm and distended, somewhat dilated. The ureter was slightly dilated in its upper 5 or 6 centimeters. On splitting the kidney into halves on its

long axis, the cortex and medulla seemed surprisingly free of disease, while the pelvis and calyces, dilated, were stuffed snugly with a dry crumbly substance, consisting largely of flakes the size of a particle of rolled oats. In color this substance was grayish-brown. There were no calcareous deposits. Upon removing the material free in the pelvis, more of it was found clinging to the pelvic wall and this in turn, was found to be markedly thickened. We estimated that at least two tablespoonfuls of the débris was removed, leaving a considerable amount attached to the pelvis.

Pathologist's report. Major Paul A. Schule examined the kidney and ureter. Gross specimen: weight 154 grams. Capsule is contracted at several points; the pelvis is lined with a dry scaly material resembling bran. Microscopic examination showed marked inflammatory changes of glomeruli and capsules of same, indicated by hyaline change and endothelial proliferation. The tubules of the cortex also showed change, and granular and swollen epithelium. The pelvis shows most extensive lesions; the lining epithelium is not of the usual transitional type. Instead, it is thicker, and of the distinct squamous epithelium type. In addition there is a heavy layer of keratin, densely packed, at least as thick as the epithelial layer itself. Further, beyond the keratin layer, is an even thicker layer of keratin flakes, loosely arranged. These flakes are what was described in the gross as a "bran-like" substance. *Beneath the epithelium,* there is a varying amount of loose œdematous connective tissue, and beneath this in turn, fibrosis, with extensive small cell infiltration, and dilatation of the collecting tubules.

The condition of the pelvis as described, is probably the primary lesion, and presents a definite example of *leucoplakia of the renal pelvis.* The sequel was a glomerular and tubular nephritis, with dilatation of the collecting tubules. No evidence of tuberculosis or active infectious nephritis.

It is scarcely necessary to say that at operation nephrectomy seemed the only wise procedure. The clinical postoperative course included several interesting events. On December 18, 1920, 11 days after nephrectomy, the patient suddenly developed a high fever with an increased pulse rate; physical and roentgen-ray examinations demonstrated a right lobar pneumonia. Daily leucocyte counts were made; their range was from 36,000 downward as the disease retrogressed by lysis, to 17,000 on December 23, 1920. On that date the roentgen-ray also indicated rapid resolution. During the pneumonia, the patient could not be restrained as he did not feel at all sick. His blood non-protein nitrogen did not increase above 52 milligrams per 100 cubic centimeters plasma.

All the urine was saved in 24 hour specimens, for 3 weeks. Whereas during the pre-operative study the urine output averaged 1680 cubic centimeters, during the postoperative collection the average was 1250 cubic centimeters. During the pneumonitis the output was lowered to 500 cubic centimeters, perhaps accounting for the lower average.

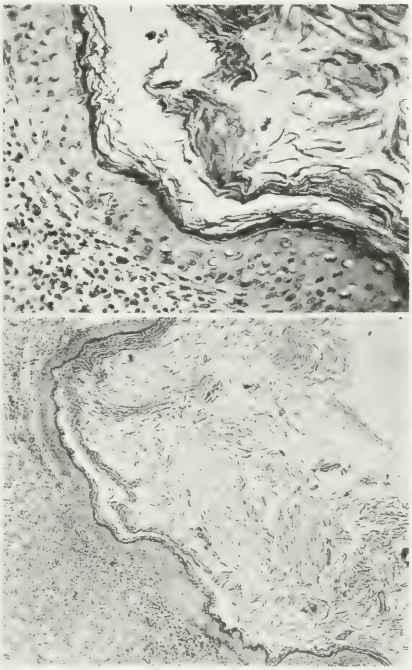

Fig. 2. Microphotograph of a section of the pelvis; in low power photograph note the general arrangement of stratified epithelium, and the enormous amount of keratin loosely attached. In the high power photograph the finer changes can be seen; individual cells lost in the process of keratinization. Submucous round-cell infiltration is also noticeable.

The lumbar wound became infected and healed sluggishly, almost typically like a tuberculous wound and sinus. Healing finally was accomplished, and the patient was discharged apparently quite well February 9, 1921.

By far the most noticeable improvement aside from an absolute effacement of the bladder symptoms, was the very rapid subsidence of the torticollis. Physiotherapeutic measures, fruitless before nephrectomy immediately brought results after the operation. Practically no deformity was present at the time of his discharge. It was conceded that the kidney condition, even though infection was never demonstrated, must have been a causative

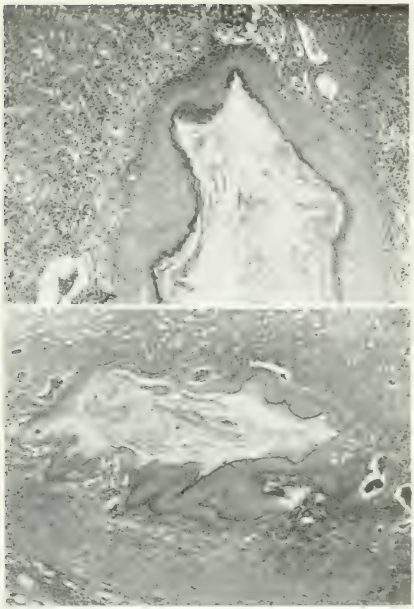

Fig. 3. A cross section of an edge of a calyx, very low magnification; enormous thickening of actual living epithelium at one point, and the same general picture as noted in Figure 2. The contiguous inflammatory changes are apparent. The higher magnification is made from a portion of the lower section. The figure illustrates the involvement as extending to the remote areas of the calyces.

agent in the production of the severe myalgic neck affection.

By way of discussion, three questions are presented, namely, whether stone, infection in general, or tuberculosis were etiological factors relative to the leucoplakia.

Certainly the symptoms, loss of weight, persistent frequency, burning micturition and hæmaturia, coupled with negative roentgen-ray and cultural findings, and the sluggish wound, strongly suggest tuberculosis. To disprove all these as evidence we have the diseased organ for intimate study and sufficient urinary data.

Other infection, connected possibly with early calculus formation, is almost a certainty in view of the torticollis; however organisms were at no time demonstrated and the stone removed from the bladder may have originated there. No history of renal colic was elicited, and had there been such it might more readily relate to the passage of epithelial clumps, an almost constant occurrence in other pelvis leucoplakias.

Certainly there was a stone removed from the bladder; a suprapubic scar was found and the patient treasured a large, smooth, white stone. In favor of the latter's origin in the diseased kidney is the widely accepted idea that chronic irritation gives rise to leucoplakia in mucous surface membranes. A rather striking symptom, relative to many of the cases reported, as brought out by Kretschmer, is the passage of the large epithelial plaques, described variously, but always giving rise to renal colic if coming from the kidney. Beselin's case had 200 attacks of colic; after a severe colic and the passage of the largest membrane noted, Beer's first case apparently recovered. We cannot believe in recovery unless the process involves only a very small area, and Beer's patient had attacks of colic for 3 years. No evidence of stone, tuberculosis, or other infection was found by Beer, similar circumstances to those in our own case. However, our patient had no renal colic, and while he admitted vague pain in the lumbar region in the past, none developed while he was in our hands; nor was there tenderness in the flank. Regarding infection, the gross kidney picture and the pathological report leave no doubt as to remote invasion of some organism.

The periods of onset and duration in reported cases vary a great deal; surely such distinct changes as we found did not develop after the first symptoms of bladder irritability. Years elapsed since the process of metaplasia began. Scrutiny of the photograph (Fig. 1) will plainly show how completely the normal lining was replaced.

Tissues deep to the mucous membrane may give evidence toward determining the age of the process. However, the epithelium in its deepest layer rested directly on a bed of granulation tissue in the specimen examined by Richey, while his patient had symptoms 22 years. In our specimen, no granulations

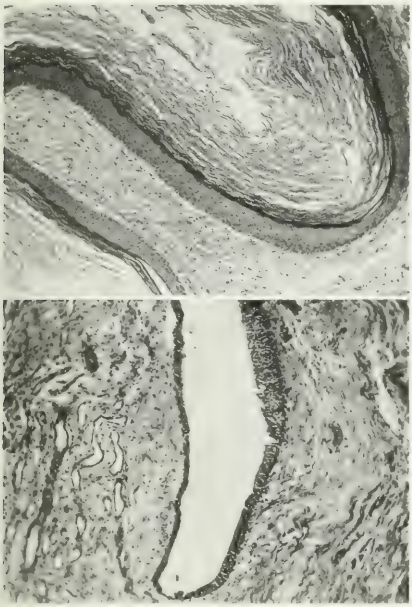

Fig. 4. Sections from a relatively normal renal pelvis and from that involved by leucoplakia; in the normal pelvis the epithelium is the usual transitional type, while in that involved by disease the epithelium is thicker and of the distinct squamous type, with a heavy layer of densely packed keratin, at least as thick as the epithelium itself. Beyond this, again there is noted the loosely packed keratin.

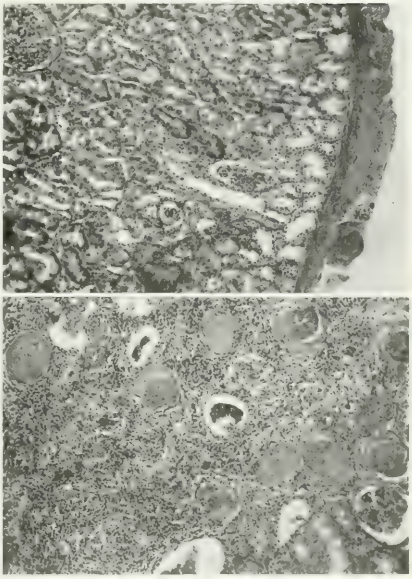

Fig. 5. Sections taken from the cortex of leucoplakia kidney; note thickening of capsule, inflammatory changes of glomeruli and their capsules, indicated by hyaline change and endothelial proliferation. The tubular epithelium also is swollen and granular.

appeared, the epithelium adjoining fibrous tissue.

Before taking up a brief general discussion of leucoplakia of the urinary tract, it will be of interest to note a few points in diagnosis regarding the fifteen reported cases involving the true renal pelvis. (Author's case included.)

Cases recognized at operation—8, as reported by Lecène, Braatz, Chiari, Beer, Hallé, Beselin, Richey, and Cumming.

Cases recognized without operation—2, as reported by Stockmann and Beer.

Cases recognized at autopsy—5, as reported by Hallé (2), Leber, Marchaud, and Rona.

Associated lesions—Tuberculosis—3 as reported by Beer, Beselin, and Hallé (ureter).

Stone—3, as reported by Chiari, Rona, and Hallé.

Pyonephrosis—3, as reported by Braatz, Lecène, and Hallé.

This summary indicates the difficulty of diagnosis in regard to leucoplakia; *a priori*, the condition in the bladder may always be recognized, while in the renal pelvis, only at operation or autopsy can one make certain of this pathology. The ureter, as Kretschmer states, also harbors leucoplakia with no pathognomonic symptoms, and has always heretofore been incriminated only by operation or autopsy.

For completeness, perhaps no other of the rare conditions found in the urinary tract is so well covered as leucoplakia. Englisch (3) and Kretschmer (1) have reviewed all the literature, the former's writings appearing in 1907, and the latter's in 1920. These authors

cite a number of the cases we have referred to in the foregoing tables. Other writers to whom we will refer are Wells (4), Morris (5), Braasch (6), Keyes (7), Adami (8), Beer (9), Haythorn (10), Ziegler (11), Osler (12), Albarran (13).

To understand the chemical processes involved in leucoplakia, we have Well's statement that it may be interpreted as a chemical alteration due to mechanical stimuli, with the formation of keratin by cells that ordinarily do not do so. Braasch, in speaking of the pathology in kidney pelves found to be dilated only at autopsy, refers to a proliferation and cornification of the mucosa with no evidence of obstruction or mechanical irritation. Keyes states however, that leucoplakia is usually due to stone or tuberculosis, and is the result of chronic irritation. Beer refers to Beselin's case of leucoplakia, in which cholesterin crystals were found attached to the plaques of exfoliated epithelium and mentions silicates as elements of the débris in his own case; here again distinct chemical changes demand explanation. Richey speaks of leucoplakia as a transformation induced by an alteration of environment wrought by a long-standing inflammatory process or a stone. Hallé mentions the high coincidence of leucoplakia and calculus but does not think mechanical irritation is the direct cause, leaning toward chronic inflammation as a better etiology. Albarran gave stone as the cause of leucoplakia.

Ziegler says of leucoplakia as given in the English translation of his text: "Epithelial metaplasia occurs most frequently in chronic inflamed mucous membranes. The change occurs in the following manner: after repeated loss of the original epithelium, the regenerating epithelium changes its character." He further states that this alteration occurs in transitional epithelium as well as in those places possessing pavement-epithelium. A small multitude of terms synonymous with "leucoplakia" has heretofore been confusing and still other terms are used erroneously. Metaplasia is perhaps a more correct expression of the process as Richey has pointed out. Other writers, notably Ziegler, Adami, Wells, and Keyes, apparently prefer "metaplasia." Richey warns against confusing metaplasia with heterotopia, heteroplasia, and anaplasia, and lucidly describes metaplasia as "the postnatal production of specialized tissues from cells which normally produce tissues of other orders." He further points out that the change embraces both a morphological and functional derangement in the cells; with a tendency toward the formation of a more highly from a less highly specialized type. Englisch and Kretschmer refer to the necessity of differentiating metaplasia (leucoplakia) from malakoplakia.

The unexplained dilatation of renal pelves with thickened cornified walls, represents in our opinion an early stage in the process of leucoplakia. Cornification, keratinization, epidermization, are terms to be applied to this early process and perhaps may be found much more often than it is generally recognized and recorded. We do not believe true leucoplakia exists often unrecognized, as such a profound change gives striking evidence at the table of either operating or autopsy room. While it gives rise to no characteristic symptoms other than the passage of epithelium in the urine (not a significant finding in our own case), symptoms of allied conditions have in all except a very few instances warranted operative interference.

One other factor relative to leucoplakia merits consideration here; namely, its relation to carcinoma. Osler, referring to this states that "the transformation of leucoplakia into carcinoma is indubitable. It is not a complication or an accident, but a distinct evolutionary development, the cause residing in the histogenesis of leucoplakia." Osler thus commits himself, but after a discussion of the process in tissues other than the renal pelvis.

Albarran was perhaps the first who ascribed leucoplakia of the renal pelvis as a cause or forerunner of carcinoma. Bauer stated that stratified epithelium in the kidney pelvis, due to metaplasia, is a common joint-finding with tumors. Schiewelbein believes carcinoma in his case of renal pelvis tumor, due to foregoing metaplasia. Taddei observes that leucoplakia likely gives rise to carcinoma in the renal pelvis and cites the case of Kischenski. Scheel states that the origin in his tumor case was

metaplasia of the transitional epithelium. Scaline concludes his case of epithelioma of the renal pelvis as due to leucoplakia and stone.

We are indebted to Kretschmer for this summary of the subject from the viewpoint of various men who have written on tumors of the renal pelvis. He refers to leucoplakia, stone, and infection as almost universally recognized forerunners of non-papillary carcinoma.

Ziegler states that epithelial tumors arising from transitional epithelium may bear the character of squamous-celled tumors. Morris, writing on the same topic, says that in transitional-celled and squamous-celled carcinoma of the renal pelvis, transformation of the lining epithelium to leucoplakia is sometimes the starting point of the squamous-celled tumor.

Finally, one is struck by a real controversy as to the origin and essence of leucoplakia. Adami discusses the opposing views of many pathologists. He himself considers metaplasia predicated by the certainty that epithelial change must simply result in another form of epithelium, and thinks the process may explain certain "cell rests." Richey quotes Orth and Schridde as saying that metaplasial conversion occurs through the mediation of cells not completely differentiated so that formative cells may abandon their attributes and revert to cells having all the powers of differentiation of the embryonic cells from which epithelium develops. The only necessity is epithelial tissue, not some other, as the end-result.

CONCLUSIONS

1. Leucoplakia of the renal pelvis is a rare condition; the bladder is more frequently involved and in the bladder one can readily recognize leucoplakia by cystoscopy.

2. The histopathological picture is that of a replacement of the normal transitional epithelium by a many-layered coating of stratified squamous epithelium showing on the surface varying degrees of keratinization. In the case herewith presented, the pelvis was stuffed with dry keratin flakes.

3. Etiological possibilities are vague and must be based on histogenetic laws and clinical coincident disease. Stone, infection, or carcinoma, occur with leucoplakia in many but not all cases.

4. While syphilis and alcoholism have a definite relation to leucoplakia elsewhere, neither seems to bear upon the affection in the renal pelvis. Inflammation of the renal or urinary mucosa probably accompanies all metaplasia but cannot definitely be ascribed as producing it.

5. The symptoms are those of related conditions, except for the painless passage of epithelial membrane. Symptoms of stone, tuberculosis, and tumor are most mentioned.

6. Operative treatment of advanced cases is certainly advisable, nephrectomy being most often indicated.

7. More diligent study of specimens obtained at operation and autopsy may bring to light a greater number of instances of leucoplakia, although this seems doubtful in view of the definite picture presented by operated cases.

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ECHINOCOCCUS DISEASE OF THE KIDNEY[1]

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ECHINOCOCCUS disease of the kidney may be of two types: (1) The primary type in which the kidney, as far as can be demonstrated clinically, is the only organ involved. This type of echinococcus infection is very rare. The case to be reported in this paper belonged to this type, as far as it was possible to determine at the operation. (2) It may be part and parcel of a general infection in which this condition is found in other organs, such as the liver, spleen, intestinal tract, peritoneum, etc.

It is generally believed that renal hydatid is one of the rare kidney lesions even in countries where echinococcus disease is of common occurrence. In this country where this condition is uncommon, there is a correspondingly small literature dealing with this subject. Lyon, in 1902, was able to collect a series of only 241 cases of echinococcus disease that were reported in the United States and Canada. Naturally the literature of renal hydatid would likewise be a small one. In the literature at my command I have been able to find 17 cases reported, in which there was kidney involvement by echinococcus. This with the case to be reported below brings the total number of kidney cases reported in Canada and the United States up to 18.

Fig. 1.—Pyelogram showing depression of the calyces by the area of calcification

THE STATISTICS DEALING WITH THE OCCURRENCE OF KIDNEY ECHINOCOCCUS

The statistics dealing with the frequency with which the kidney is involved in a general echinococcus infection are somewhat at variance, between .02 to 5.4 per cent. Regarding the frequency with which the kidney is involved in echinococcus disease, Garceau stated: "The kidney is affected in about 1 per cent of the cases, according to Finsen, who examined 255 cases of the disease, and found only three, or 1.17 per cent, in which the kidney was affected. It is interesting to observe that in these 255 cases the disease began in some organ in the abdominal cavity in 92 per cent of the cases. Thomas collected reports of 307 cases occurring in Australia between the years 1868 and 1877. Among these there were only 2 cases, or .065 per cent, in which the kidney was affected. Morris collecting the figures of various observers got together 2,111 cases and among these the kidney was affected 115 times, or 5.44 per cent. Gardner, who had a large personal experience in treating hydatid disease, is inclined to believe that the number of kidney cases must be very small. He makes the comment that the large percentage given by the other observers must be due to the fact that their lists were compiled, not from personal experience but from published reports of others. These results must be misleading, for, owing to the comparative frequency of echinococcus of the liver and lungs, many cases must have passed unpublished, whereas it is probable that the renal cases on account of their rarity have been more commonly reported.

Gardner's opinion is confirmed by the figures of Cromwell and Vegas, who in a list of 1696 cases of hydatid disease occurring in Buenos Ayres, found the kidney affected only 36 times, or .021 per cent.

G. Y., male, Greek, age 32, referred by Dr. George Parker, Peoria, Illinois. In 1917, according

[1] Read before the Chicago Pathological Society, March 28, 1921.

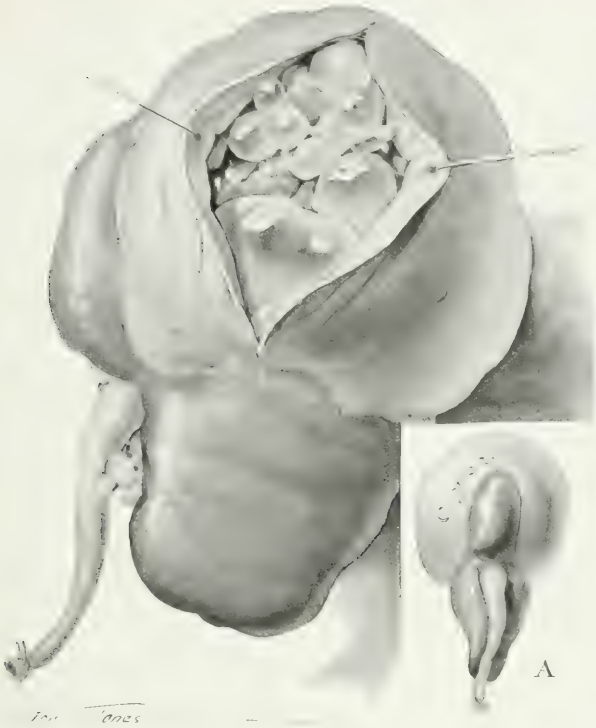

Fig. 2. Showing echinococcus cyst occupying upper half of kidney.

to the patient's statement, he had an ulcer of the stomach, and influenza in 1918. Venereal disease denied. Patient was cystoscoped three times in May, 1921, and tumor of the right kidney was diagnosed.

Present complaint. When patient entered the Presbyterian Hospital, he complained of pain over the right kidney region, frequency of urination, painful urination, hæmaturia and loss of weight.

Symptoms began one year ago with an attack of hæmaturia which lasted 2 weeks. At that time he had an attack of severe pain over the right kidney region, lasting 2 hours, which radiated to the groin and back. Morphine was required for relief. Two days after the attack a "small round body about the size of a pea was passed" which the patient described as soft, with tiny particles of gravel in it. When allowed to dry it was crumbly and the particles had the appearance of gravel. Nothing was passed in the urine since that time. About 2 weeks after the first attack of hæmaturia he had a second attack which occurred without colic. This lasted about a week. No hæmaturia noticed since that time.

Pain over the right kidney began with hæmaturia. He has had ten or twelve attacks during the last year, lasting for a few days each time. Pain is described as a dull ache along the twelfth rib, extending around in front to the level of posterior axillary line. Frequency of urination is slight, but has been present at times. He has lost about 2 pounds in 2 months.

Examination of abdomen showed no tenderness, rigidity, or tumor masses. The kidneys were not palpable and not tender to fist percussion. Cystoscopy showed the bladder negative. The ureters were catheterized without difficulty or obstruction Phenolsulphonepthalein test was made, and the

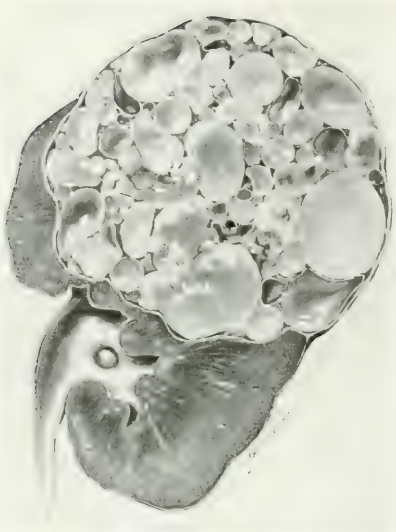

Fig. 3. Bisection of kidney

dye appeared in 6.5 minutes on the right side and 6 minutes on the left side. Cell count and cultures showed the following:

	Cells	Cultures
Bladder	30	Sterile
Right Kidney	50	Sterile
Left Kidney	30	Sterile

Roentgen-ray examination. At a point near the upper pole of the right kidney there is a shadow which is apparently the lower margin of a mass the envelope of which is calcareous in nature. This curved calcareous line when followed outward and upward is incomplete, so that only part of the envelope is calcareous. The presence of this area of calcification was demonstrated in the specimen removed at operation.

Pyelogram (Fig. 1): The upper calyx is deflected inward and the middle calyx deflected downward at a point where the calcareous mass impinges upon the pelvis.

Operation, June 28, 1921. The right kidney was exposed by the usual oblique lumbar incision. The perirenal fat was dissected away, exposing a large, firm, globular mass about 20 centimeters in diameter, occupying the upper half of the kidney and bound by firm fibrous adhesions to the surrounding structures. The kidney pedicle was clamped, doubly ligated, and clamps removed. The ureter was secured and ligated about 10 centimeters distal to the pelvis, and the kidney removed. During the operation a very large hole was torn in the peritoneum, because of the difficulty in delivering the tumor and because of the presence of adhesions. This large opening gave an excellent opportunity to examine other organs before closing the wound. The liver was very carefully gone over for the presence of echinococcus cysts, but apparently it was normal. Exploration of the rest of the abdomen was negative.

The patient had a rather stormy convalescence for about 10 days and complained of a great deal of abdominal pain, nausea and vomiting. At one time 300 cubic centimeters of fluid were obtained from his stomach and a provisional diagnosis of acute gastric dilatation was made. After his gastric symptoms had subsided, patient made an uneventful recovery.

Gross description. The kidney measured 13 centimeters in length, 7 centimeters in width and 5.5 centimeters in thickness. In the upper, outer half was a tumor 11 centimeters long by 11.5 centimeters in width and 8.5 centimeters in thickness. The tumor projected from the upper half of the outer convex border and extended obliquely downward toward the lower pole so that the lower border was 7 centimeters above the latter point (Fig. 2). Exteriorly, the mass was firm and smooth except for very slight roughening, caused apparently by bundles of fibrous tissue, and the color was pink to yellow white. When opened, the tumor proved to be a sac with a firm, fibrous wall about 1 millimeter thick, smooth, and yellow inside, and from which a cheesy yellow material could be scraped in small quantities. The inside of this tumor was filled with many small cysts, varying in size from a few millimeters in diameter to 10 by 6 by 2 centimeters (Fig. 3). Some of them were filled with clear fluid; others were empty and several layers thick, the walls composed of a gelatin-like material, rolled up like a scroll in some instances. Quite a number were free in the sac and were filled with a clear, colorless fluid which could be seen through the wall of the cysts which was almost transparent.

A pre operative diagnosis of tumor in the right kidney was made, this diagnosis being based upon the following facts:

1. The presence of pain in the right kidney region.
2. Hæmaturia, which had been first noticed about a year ago.
3. Slight loss of weight.
4. The pyelogram.
5. The presence of small areas of calcification interpreted as being due to calcification in a tumor.
6. Absence of signs of infection in the urinary tract demonstrated bacteriologically.

The diagnosis of tumor was correct so far as it went, but the nature of the tumor was not recognized. In spite of the patient's

age (32) a tentative diagnosis of malignancy was made, based partly upon the fact that malignant tumors of the kidney are the most frequent renal tumors and, furthermore, because the calcifications seen in the roentgenogram were interpreted as being calcifications in a malignant tumor. This decision was based upon a previous experience in which somewhat similar calcifications were seen in a case of malignant papillary cystadenoma of the kidney.[1]

One fact in the history deserves mention and that is that the patient stated that he passed a small round body the size of a pea, which he described as being soft in consistency and that it had particles of gravel in it. Later he again passed some shreds in his urine, which he brought to Dr. Parker and which Dr. Parker sectioned. This proved to be a mass of necrotic tissue, and it had nothing suggestive microscopically upon which a diagnosis of echinococcus could be based.

A pre-operative diagnosis of echinococcus of the kidney is not made very often. In the case which Osler had, the diagnosis was echinococcus, possibly in the right kidney, diagnosis being based upon repeated attacks of right-sided renal colic associated with the passage of daughter and granddaughter cysts in the urine. Schmidt, in his report of a case, says he saw his patient twice, an interval of about a year elapsing between the times. When first seen an operation was advised, because he "had strongly suspected a new-growth." "Upon the patient's return a year later he brought with him a specimen of urine which contained 25 or 30 clear oval and round-shaped pearls of varying size and from this evidence there was no question as to the character of the trouble." Russell and Kilbane failed to make the correct diagnosis before operation. "Upon questioning the patient after operation he stated he had passed grape-like cysts in his urine and had this been known a correct diagnosis should have been made."

Mercier diagnosed a lipoma in his case, cyst not being suspected owing to the long period of development.

[1] Kretschmer and Moody. Malignant papillary cystadenoma of kidney with metastases.

Leighton and Lewis made a pre-operative diagnosis of tumor, the nature of which was uncertain.

Haynes, in his case, made a diagnosis of pneumonia of the lower lobe of the right lung and acute appendicitis; patient was operated upon. While liberating the appendix a hard mass was felt in the upper part of the field. It was thought to be a kidney containing a large calculus. In freeing the kidney a soft spot in its anterior surface was ruptured and some fluid and several small, whitish spherical bodies floated upward and escaped through the wound.

A pre-operative diagnosis of hydatids of the left kidney was made by Fauntleroy, who based his diagnosis upon pain in the left lumbar region and the passage of small cysts in the urine.

In Allaben's case the patient gave a history of previous operation for echinococcus of the mesentary and omentum.

The diagnosis can be made in cases in which the history brings out the fact that the patients have passed cysts in the urine, or, better still, if the patient brings the cysts in with him.

Before the cyst communicates with the pelvis of the kidney, diagnosis is very difficult; after the cyst has reached a certain size, the diagnosis is that of some sort of tumor of the kidney. The diagnosis should be relatively simple after the cyst communicates with the kidney pelvis so that small cysts are passed with the urine. In several instances a diagnosis of echinococcus disease was made on finding cysts in the urine. Without this evidence, a differential diagnosis must include the various lesions of the kidney as well as various other intra abdominal lesions.

NATIONALITY

In 6 of the 18 cases the nationality was not stated. In the remaining 12 cases the nationalities were:

Italians	5
Greeks	3
German	1
Swede	1
Russian Pole	1
English	1

It is evident that echinococcus of the kidney is rare among the native born.

SEX

There was a great preponderance of males over females: 15 males and 3 females.

AGE

The following were the ages:

	Cases
20 years	1
21 years	1
23 years	1
32 years	1
34 years	1
35 years	1
38 years	1
43 years	1
45 years	1
46 years	1
49 years	1
52 years	1
53 years	2
55 years	1
58 years	1
Age (not stated)	1

SUBJUNCTIVE SYMPTOMS

Early in the course of the disease there may be no symptoms in case the tumor is small or before the cyst has ruptured into the renal pelvis. After the cyst has enlarged, it may be felt by careful palpation.

The presence of a tumor was recorded by Downes, Keyes and Busch, Leighton and Lewis, Mercier, Stavely, Marsh and Young.

In some of the case reports the definite statement is made that a tumor mass was neither felt nor demonstrated: by Fauntleroy, Russell and Kilbane, Osler, Schmidt, and by Young in his 2 cases. In my case abdominal palpation was negative.

Although in the majority of cases, no tumor was palpable, local findings on one side or the other were demonstrable upon physical examination: right kidney enlarged and tender (Guiteras), tenderness over the right iliac fossa with rigidity of the abdominal muscles (Haynes), flatness in the axillary line extending to the crest of the ilium (Keyes and Busch), tenderness in the region of the spleen and increased area of liver dullness (Kinyon), a slight tenderness over the right kidney (Russell and Kilbane), and tenderness and muscle spasm in the epigastrium (Young).

PAIN

When a patient consults the physician, he does so on account of pain and this symptom is the one most frequently present. The pain may be due to the cyst and is often referred to the region of the kidney, not infrequently being of a colic-like variety, due, no doubt, to the passage of small or large daughter or granddaughter cysts. In some instances in the case reports mentioned the renal colic was due undoubtedly to the passage of clots, inasmuch as the renal colic was present during the time of active bleeding. As stated above, the pain was most frequently referred to the lumbar region, or over the tumor. Pain in the groin was noted by Guiteras; in the epigastrium by Young; in the abdomen by Haynes; in the region of the liver by Keyes and Busch; and in the kidney and bladder by Kinyon. In only one case (Schmidt) pain was referred to the glans penis.

Painful micturition was noted by Allaben, Fauntleroy and Kinyon, and burning on urination was present in one of Young's cases.

Hæmaturia was mentioned in 5 cases: Young, Guiteras, Marsh and Kinyon, and in the case reported in this paper.

The passage of cysts in the urine were noted in the cases of Fauntleroy, Young, Russell and Kilbane, Schmidt and Osler. In the case reported here the patient gave a very definite history of the passage of what in the light of subsequent events undoubtedly were cysts.

EOSINOPHILIA

Echinococcus disease is one of the conditions which is supposed to produce an eosinophilia in the blood. This was characteristic in the case reported in this paper since prior to operation an eosinophilia of 8 per cent was found. A recent examination of the blood by Dr. George Parker showed an eosinophilia of 7 per cent.

In this connection the statement by Downs that in his case there was no eosinophilia, is interesting.

ECHINOCOCCUS FIXATION TEST

Young's case reports are the only ones which indicate that this test was made, and he states that the test was positive in one

case 4 weeks after operation. In his second case the test was positive before operation and negative 26 days later; in his third case it was positive 35 days later. In my case, tests made 10 months after operation were negative with human cyst fluid and positive with pig cyst fluid.

It would appear that this test would be of great value in cases in which echinococcus infection is suspected before operation. According to Gallart-Monés, the reaction is of absolute value when it is positive because the test is specific.

Whether or not the intradermal reaction will be of value as an aid in the pre-operative diagnosis, remains to be seen.

PYELOGRAMS

Records of pyelograms made prior to operation were found in but one case, namely, in Young's, who states that an abnormal pelvis was present. In my case the pyelogram appeared as if it were being impinged upon by a mass from above (Fig. 1).

Braasch, in his monograph on pyelography, does not mention pyelography findings in this rare disease. Whether or not a pyelogram typical of this disease can be obtained, so as to aid in diagnosis, must remain for the future to determine. As this disease is not common it will probably be some time before a classical pyelogram, or what constitutes a typical pyelogram is established.

TREATMENT

Various forms of surgical treatment have been advised and practiced from time to time, but some of them are considered obsolete today.

1. *Delbet's operation.* This operation was first suggested by Delbet and performed for hydatids of the liver. However, this operation cannot be performed in most cases of renal hydatids, although cases successfully operated upon by this method have been reported by Lejars and Billot.

2. *Nephrostomy.* This operation is rarely if ever used at the present time and was resorted to in the early period of kidney surgery. There may be certain instances in which, because of the extreme weakened condition of the patient, the extensive size of the cyst and the presence of adhesions, this method may be employed as the only way out or preliminary to a later nephrectomy. As a general proposition, however, it may be stated that this procedure is obsolete.

3. *Resection.* Undoubtedly this is the method of choice in cases in which it is possible to carry it out. However, in the largest number of instances it is not possible to do this. Where small cysts are present, or in cases in which the cyst may be pedunculated, this is easily the method of choice, especially if the cyst is located in one of the upper poles or if the tumor springs from the convex border. In instances in which the tumor takes origin from the hilus or where the tumor is adherent to the vessels, this method would not be as desirable as nephrectomy.

4. *Nephrectomy.* This seems to be the method of choice with the surgeons of this country and technically should offer no more serious difficulty than any other type of nephrectomy. Of the 18 cases reported in this paper, nephrectomy was carried out nine times. Fauntleroy treated his case with carbolic acid and Mercier practiced removal of the cyst. One of the 9 cases operated died, this being the case reported by Leighton and Lewis. Complete recoveries were reported in the remaining cases.

J. E. Allaben's Case

Female, age 52, German. Had been ill in Germany more or less for 17 years. Laparotomy was performed in Greifswald Hospital, in 1879, for echinococcus cysts of the mesentery and omentum. Shortly after, a number of cysts were passed from the bowels. Since the operation the patient has performed the duties of a housewife but has felt that her ailment was not entirely relieved. When first seen she was confined to bed, weak and emaciated; she suffered retention of urine, was constipated, and the abdomen was moderately distended but not tender on pressure. Tonic treatment was instituted, which was followed by good health for a short time. Then she began to complain of pain in the right arm and leg. Her mind also seemed to be affected. Sensation in right arm and leg diminished and grasp of the right hand was weak. In a week these paralytic symptoms had greatly increased and in 2 weeks there was complete paralysis of the right side. She gradually declined and died at the end of 6 weeks.

Autopsy. The intestines and stomach adhered to each other in one inseparable mass. Six hydatid

tumors, from the size of a hen's egg to that of a goose egg, were attached to the bladder at various points; one hard tumor the size of a hen's egg was in the right side of the pelvis. There was a large one in the capsule of the liver on its upper surface adherent to the parietal peritoneum. The spleen was contracted and enclosed in a mass of tumors of various sizes and bound to them by inflammatory formations. The kidneys had several small cysts on their outer surfaces. The parenchyma of the kidneys and liver was normal. A mass of tumors was located on the omentum under the umbilicus. Another mass of tumors, which originated in the omentum and which was adherent to the liver, was under the ensiform cartilage. Tumors were also found at various points on the peritoneum lining the abdominal walls.

W. A. Downes' Case

Male, age 49. For 15 years patient had complained of pain and of a mass in the left side, but barring one or two attacks of some discomfort he had had no serious trouble until 2 years ago when the attacks became more frequent and the large mass interfered with his going out and attending to his business. Examination showed a smooth nonfluctuating mass filling the entire left side of abdomen. The ureters were catheterized and showed a rapid flow of urine from the left side; the right side showed a normal flow. The urea on left side was much diminished. Blood examination showed no *eosinophilia*.

Operation. The kidney was found to be the seat of a thick-walled cyst, very adherent and separated from the descending colon with difficulty. Convalescence was slow but entirely satisfactory.

A. M. Fauntleroy's Case

Male, age 45, had suffered for years at irregular intervals with pain in left lumbar region, radiating to the hip, thigh (of same side), and bladder. He had marked abdominal tenderness, and frequent painful and often prolonged efforts at micturition with discharge of turbid urine. The discharge was usually preceded or accompanied by the escape of small cysts containing translucent fluid. At times the little bladders were discharged already broken and devoid of contents. A diagnosis of hydatids of the left kidney was made.

Upon examination no enlargement or tumor was found in the region of the kidney. From this fact and from the apparent readiness with which the patient's hydatid cyst ruptured into the *renal pelvis*, the inference was that the pyramidal structure of the kidney alone was implicated. The ready escape of the so-called daughter vesicles *per urethram*, together with the above circumstances, offered grounds for a favorable prognosis. Patient was treated with mild laxatives, warm applications to abdomen, an anodyne for the paroxysmal pains and carbolic acid internally to destroy the hydatid cyst.

Guiteras' Case

Female, age 20. Three years ago patient had an attack of severe pain in right lumbar region and groin, lasting for 3 days, during which time there was hæmaturia. One month ago she had an attack of acute pain in the same locality. The urine was bloody and voided with difficulty. The severity of the pain gradually diminished, but more or less pain on that side remained. On the first visit her temperature was 98.4° to 100° F.

Examination. The right kidney was enlarged and tender, extending over to the median line. Cystoscopy showed the bladder to be normal. The ureters were catheterized. Urine from left side was secreted normally and found normal upon examination. The urine from the right side flowed more slowly; was very pale and contained a trace of albumin, a few blood and pus cells, a few hyaline casts, renal epithelia, uric acid and triple-phosphate crystals. No exact conclusion was arrived at regarding the case and an exploratory incision was made. The kidney was found to be much enlarged; the upper pole enlarged and adherent to the diaphragm. The lower pole was smaller and twisted. A cyst, with a thick white sac, 3½ inches in length and 2½ inches in width was seen springing from the anterior surface of the kidney and pelvis. This was opened and a considerable amount of amber fluid and a number of small white daughter cysts escaped. The outer surface of sac was dissected away, and the remainder treated with carbolic acid and alcohol. During the first week after operation, the temperature ranged from 100° to 104° F. Pulse was 136 due to ether pneumonia; then became normal, and the patient left the hospital with the wound healed.

I. S. Haynes' Case

Male, age 32, Italian, admitted to hospital December 26, 1901, for operation on double inguinal hernia.

Examination. Tenderness was present over the right iliac fossa with some rigidity of the overlying abdominal muscles. An ice bag was applied to the region and calomel given in divided doses. At 9 P.M., same day, temperature was 99.4° F., respiration 26, pulse 84. The next morning the pulse and respiration were the same and temperature was 102°. Epsom salt had been given early in the morning followed by several bowel movements. Examination of lungs showed dullness, prolonged, high-pitched respiration, a few râles, absence of tactile fremitus at the base of the right lung behind His abdominal symptoms were more severe, muscular rigidity spreading to include the right rectus, and there was increased tenderness over the appendix.

Diagnosis. Pneumonia of the lower lobe of right lung and acute appendicitis. On December 30, the evidences of acute appendicitis having rapidly increased in severity, operation was decided upon despite pneumonia, as his chances seemed better without the appendix than with it. The condition

about the cæcum was noteworthy. Adhesions of long standing covered the cæcum and ascending colon and united them firmly with the abdominal wall, the small intestines and the omentum. After considerable difficulty the appendix was found lying posterior to the cæcum and extending upward; removed. While liberating the appendix, a hard mass was felt in the upper part of the field. The wound was enlarged upward. The mass lay deeply in the loin beneath the intestines welded together by old adhesions. It was exposed and because of its hardness and position was thought to be a kidney containing a very large calculus. In freeing the kidney a soft spot on its anterior surface was torn through and some fluid and several small whitish spherical bodies floated upward and escaped through the wound. The atrophic remains of the vessels and ureter were tied off, although there was little need for the ligature, as on examining the specimen no previous vessels or ureter could be seen. The wound was flushed and closed over a wick and tube drainage because of the probable infection through escape of the cysts and fluid. The wound healed rapidly to the drain. The pneumonia increased in severity and patient died 8 days after operation. Autopsy was not permitted. During the operation the liver was palpated and found not enlarged or nodular but unusually hard.

The cyst measured 6 by 4½ centimeters. The shape was distinctly that of a contracted kidney, one-half of which was slightly larger than the other. The wall varied from 1 to 2 centimeters in thickness and was fibrous without, lamellated toward the center, and covered within by a finely granular parenchymatous layer. In places the lamellated portion was calcified. The cavity was composed of one large and two smaller communicating loculi, which contained a score of translucent parasitic cysts of various sizes. In these cysts there were hooklets and cholesterin crystals but no scolices; the walls were of the usual lamellated character. Microscopic examination showed no traces of renal tissue, the outer wall being composed of dense fibrillar connective tissue infiltrated with lymphocytes.

William C. Keyes and Frederick C. Busch's Case

Male, age 53, had pain in the right side, in the region of the liver; coughed up greenish fluid of a disagreeable odor and of an acrid taste. The right chest was bulging; the right pleural cavity was aspirated; could be felt just below the ensiform cartilage and to the right; also explored with the hypodermic needle with no result. Upon percussion the liver flatness did not extend downward below the free border of the ribs, but extended as high as the nipple in front and, at the same level, to the median line behind: In the axillary line, flatness extended to the crest of the ilium. Inguinal hernia on the left side.

Patient died; autopsy was performed.

Left kidney was large and pale. The right kidney was covered anteriorly by a large cyst; anterior and upper half atrophied to half its normal size; the posterior half flattened from the pressure of the cyst.

The cyst measured 18 centimeters in its long diameter and 14 centimeters in its short diameter, pressing upon the right kidney below and extending to the diaphragm above. It contained a large number of daughter cysts, many of them filled with a clear, limpid fluid, and of great beauty. Others were collapsed. In these, scolices with hooklets were demonstrated. Since the capsule of the kidney was continuous over the cyst, the latter probably arose in the cortex, leaving a cup-shaped excavation in it, which was occupied by one end of the cyst.

The urinary bladder contained about 47 cubic centimeters of amber-colored urine. Examination of the latter revealed nothing of importance.

J. J. Kinyon's Case

Male, age 38, Swede; admitted to U. S. Marine Hospital, New York, March 8, 1890; died August 19, 1890. Patient was in hospital from June 14, 1889, to June 29, 1889. Diagnosis: chronic Bright's disease. He complained of a steady and severe pain in the back and in the region of the kidneys. He had to pass urine every hour in small quantities; urine contained considerable blood. He was unable to keep anything on his stomach and vomited immediately after eating. Tenderness was present in the region of the spleen and there was an increased area of liver dullness. The urine was examined and found to contain large quantities of albumin. Patient was discharged June 29, 1890, much improved. About 3 years before this time he was seized with severe pains; passed a very large quantity of blood with his urine; pain especially severe on urination. This attack lasted about a week. He experienced no further trouble until he had similar symptoms about a week before admission to the hospital, June, 1889. After his discharge from the hospital he felt somewhat better for several months. About 3 months before admission to hospital, March, 1890, he began to grow worse again; return of same symptoms, at intervals, which increased in frequency until he came to hospital, at which time he had lost considerable weight and was very weak. When admitted he had no appetite, and suffered from nausea and vomiting, accompanied by severe pain in the stomach, and was constipated. He had an organic urethral stricture of long standing and was admitted to the hospital under that diagnosis.

Examination showed a very small meatus and a stricture in the membranous portion of the urethra. The urine showed a large quantity of albumin. A few days later he complained of severe pains in the region of the bladder and was cystoscoped. On the posterior wall of the bladder, near the ureteral orifice, was seen what appeared to be a tumor—round and of a dark red color. The blood vessels were seen and what appeared to be villi on the surface of the mucous membrane. The patient was dis-

charged "improved" on March 28 and readmitted for chronic Bright's disease.

After his readmission he gradually improved, and the vomiting after meals stopped; the pains in the region of the kidneys and bladder ceased, except occasionally and then only for a day at a time. His urine was examined from time to time and was found as a rule free from albumin. The bladder was cystoscoped several times and the results were similar to the first time. The urine was free from blood but during the night of June 3, it suddenly became dark colored, due to a large quantity of blood. Blood was found in the urine for 2 or 3 weeks, then the urine became clear again, but on July 22 it again contained blood. The average amount of urine passed was 2,500 cubic centimeters per diem. The examination showed considerable albumin, probably due to the presence of the blood. He suffered loss of weight and strength. He continued to pass blood in the urine until July 26; chloroform was administered and a suprapubic cystotomy was done in order to explore the bladder. A thorough examination of the bladder walls revealed several blood clots but no tumor. Prostate gland examined before the operation, was found to be only very slightly enlarged, very hard and firm. After the operation, a very severe vomiting spell occurred; then no nausea for several days, followed by nausea and vomiting which continued until his death.

Soon after the operation patient complained of severe pain over the left kidney, which lasted for a few days and then disappeared. He became much emaciated and very weak. During the period of severe pain (night of August 4) temperature suddenly ran up to 40° C., and the pain was much increased. During the succeeding week it dropped to 36° C. on the night of August 14, and remained at 37°C. or a little above until death. Urine, examined again on August 14, contained a large quantity of albumin. For 48 hours preceding death patient could be aroused only with difficulty sufficiently to understand when he was spoken to.

Rigor mortis was well marked. Thorax opened; pericardium normal. Heart in systole, small; walls indicated eccentric hypertrophy; valves normal. Slight (old) interlobular pleurisy in both lungs; otherwise normal. Right kidney about two or three times normal size and adherent to surrounding tissues. Kidney's surface and substance one mass of cysts; a large abscess near the center of the kidney. Hæmorrhages were found in some of the cysts; the latter the result of echinococci formations, as was revealed by microscopic examinations. Capsule non-adherent. Left kidney was somewhat larger than right; with the exception of a large abscess in the right, the condition was the same. Kidney was firmly adherent to the spleen and surrounding tissues. The liver was about twice the normal size, fatty and cirrhotic, its surface covered with numerous cicatrices and cysts. The latter throughout the liver substance had the same appearance and same formation as those of the kidney. The spleen was much enlarged, firm and apparently normal. The intestines were apparently normal. The bladder had a ridge or elevation across the posterior and dependent portion which contained cysts of echinococcus formation as in the kidneys and liver. The mucous membrane of the bladder was thickened and inflamed. The brain and spinal cord were not examined.

W. E. Leighton and B. Lewis's Case

Female, age 35, Italian, entered hospital because of a tumor in right lumbar region; suffered great pain and distress. The tumor had been present for about 4 years; had gradually increased in size until patient was no longer able to work because of its size, feeling of weight, and pain.

Examination revealed a tumor in right lumbar region, which bulged outward and forward. Percussion showed it to extend from the border of the ribs to the iliac fossa. It was smooth, rounded, and solid to the touch, except at a point near the umbilicus where it felt soft or cystic. Though it was continuous with the liver dullness, it was movable. It occupied the space of the right kidney. The left kidney was not enlarged.

Urinalysis: specific gravity, 1,020; acid; trace of albumin; no sugar. The sediment showed a few granular casts, round and squamous epithelium and many leucocytes.

Tumor of the right kidney was diagnosed, the nature of which was uncertain.

Cystoscopic examination showed normal bladder. The left ureter was easily catheterized and clear urine collected. The right ureter could be catheterized only for about 1 inch, from which oozed a turbid fluid. The specimen from the right ureter showed only pus cells with no kidney elements, while that from the left kidney corresponded with the previous examination and showed chronic nephritis of the left kidney.

Exploratory operation. The right kidney was exposed by an oblique lumbar incision; a white, hard tumor similar to a thick-walled ovarian cyst instead of its usual appearance. In an effort to free the cyst from where it was adherent to the ascending colon, the tumor ruptured and a small amount of fluid with many egg-like cysts escaped; there was then left only a thin-walled sac, which represented the remnant of the kidney.

Patient died 5 days after operation. No autopsy; but the lungs, heart, spleen, and left kidney were removed through the operative wound. No other cysts were found. The heart was dilated and showed an insufficient valve. The left kidney was enlarged and showed chronic changes.

J. O. Marsh's Case

Male, age 53. Patient had not felt well for several days when on April 1, 1866, after lifting a box of fruit, a sharp pain occurred in the left lumbar region which passed off in a few hours. During the follow-

ing 2 days patient voided bloody urine. There was more or less pain in the region of the left kidney from this time on; he passed a little blood in the urine once or twice, but there was no special urinary trouble.

General health declined. During the first year a tumor was perceived in the left lumbar region which increased downward and forward. Occasionally lancinating pain radiated from the spine, through the tumor, and down to the left testicle, which at one time was swollen and tender. No sexual desire.

The tumor occupied the whole left side of the abdominal cavity and extended 2 inches to the right of median line. The ribs and abdomen protruded on the left side. The tumor was smooth with obscure fluctuation. Percussion was dull as high as the fifth rib. Slight tenderness was present in median line and left lumbar region. The urine was scanty and for 3 or 4 days before death none was voided. Patient died June 15, 1869.

Autopsy. Extreme emaciation. The intestines were adherent to the tumor and to each other. The tumor measured 29¾ inches, long circumference, 13 inches transverse; weight was 10 pounds. Examination showed it to be a hydatid cyst.

O. F. Mercier's Case

Male, age 55. About 17 years ago patient first noticed an indolent tumor in the right renal region, gradually increasing in size until it attained the volume of a child's head. Little inconvenience was experienced until 2 years ago, when pains occurred which became almost unbearable during the past weeks.

The tumor was situated about 15 inches to the side of the crest of the ilium, measuring 7 inches in its long axis and 4 inches transversely. Palpation caused intense pain. The tumor appeared to be rather resistant but was not soft; no fluctuation, hardness or nodules. It could not be separated from the overlying tense skin; therefore it was thought to be a lipoma. Cyst was not suspected owing to the long development.

Operation. A right lumbar incision was made and an incapsulated growth found. The capsule was incised and an attempt made to decorticate same, but because of many adhesions, both superficial and deep, the cyst was removed entire. A considerable amount of fluid escaped. There were many smaller cysts the size of a small hen's egg, all more or less adherent to each other. In detaching these, two or three ruptured, with escape of considerable thick, grayish pus and numerous small daughter vesicles. Further search was made until all of these were found and removed, about 20 in all, after which the mother vesicle was enucleated. Recovery was complete in 3 weeks; after 5 months, no recurrence.

H. Minet's Case

Minet reported the findings in a specimen of a calcareous kidney associated with hydatid cyst, the clinical history and macroscopic appearance of which he had presented to the Urologic Society in March, 1919. At that time no definite diagnosis was made. Gregoire and Chevasse examined the specimen and found that an intrarenal cyst had developed at the lower pole within the capsule, compressing the adjacent cortical substance, these forming a slight sclerosis invested by the capsule proper. The internal membrane was continuous with its leaflets, giving to the calices a characteristic striated and zigzag appearance. The calcareous deposits were situated between these leaflets, more abundant at the dependent portions than in the neighboring renal tissue; the membrane proper was partially transformed into a calcareous shell. The uneven partitions of these calcifications gave the roentgenograph picture of a vacuolated and irregularly stratified appearance quite different from the picture of the renal calculus of the pelvis, which was found in the same kidney and which increased the interest in this exceptionally race case.

William Osler's Case

Male, age 58, Englishman. Farmer; formerly a butcher for 15 years. Patient enjoyed good health until about 4 years ago when he had a severe attack of nephritic colic on right side lasting only a short time and quickly relieved. He had no further trouble until 2 years afterward when he had a similar attack, confining him to bed for several weeks. Some days he was better but always worse on exertion. After a period of improvement for several weeks, during which time he was able to attend to his farm duties, he felt a pain and uneasiness over right kidney, followed in a day or two by pain at the point of the penis, which continued several hours and was relieved by the passage of gelatinous masses in the urine. These bodies, hydatid, he has continued to pass at intervals of from 2 to 4 weeks. The discharge was always preceded by an uncomfortable feeling of fullness in the region of the kidney and pain or uneasy sensations at the penis. With the exception of these attacks of pain and distress in the urinary organs, prior to the discharge of the hydatids, he enjoyed good health. He has lost no weight, his appetite is good, and bowels regular.

The specimens consisted of ten or twelve hydatid cysts, ranging in size from a pea to a grape and contained a small quantity of urine. They were evidently the daughter cysts of a larger one which was in communication with the urinary passages. Several of the cysts contained smaller ones (granddaughter cysts). On examination of the urine in which they were, numerous hydatids and hooklets could be seen.

J. I. Russell and E. F. Kilbane's Case

Male, age 46, Italian. Eight days before admission to hospital he had a chill and fever followed by pain and burning in right kidney region. No nausea or vomiting and no urinary symptoms were present other than that patient thought that the

urine was a little darker during the attack, but he had noticed no blood. Upon further questioning after operation, he stated that he had observed small grape-like cysts in his urine. Had this been known before operation, a correct diagnosis should have been made.

Examination showed slight tenderness over the right kidney; no mass could be felt. X-rays were negative. Urine was normal except for a few pus cells.

Cystoscopic examination showed the bladder urine very turbid, the last portion of catheter being thick pus. The bladder mucosa was markedly congested. The left pelvis was easily catheterized and a prompt flow of clear urine was obtained. The catheter passed into the right pelvis very readily but there was no flow of urine although several catheters were used. The fluid injected into the right pelvis to start the flow came back very turbid and contained a large number of pus cells.

Operation. Right nephrectomy was done through an oblique lumbar incision. The kidney was situated very high and the seat of a large semifluctuating tumor with apparently very little, if any, kidney tissue left. Recovery.

The kidney measured 16 by 13 centimeters. About 3 inches of the ureter, which was about 6 centimeters in circumference and very much thickened, was removed with the kidney. The kidney tissue had entirely disappeared and none was recognized microscopically. The entire kidney was occupied by a large echinococcus cyst with daughter cysts, the former communicating with the pelvis.

Louis E. Schmidt's Case

Male, age 21, Greek. The onset of trouble began 7 years ago when patient experienced an aching sensation in the region of the left kidney. The pain did not radiate; no chills or fever; no urinary symptoms. On one occasion the pain increased in severity while voiding urine, at which time the patient passed a globular, jelly-like mass from the urethra. The second attack about 5½ years ago, was similar to first only more severe; at this time patient suffered actual pain radiating from the lumbar region to the glans penis and culminating when a large number of globular masses was passed *per urethram*. Since the second attack, succeeding attacks increased in severity. These attacks were accompanied with severe excruciating pain in the left kidney, left ureter, and glans penis. Patient passed possibly several hundred cysts up to date of operation. He is fairly well nourished; but his strength and general health have failed quite rapidly the last 5 or 6 months.

Operation. An incision was made over the left kidney, exposing the kidney and a tumor. The character and extent of the involvement made nephrectomy imperative. The wound was closed and patient discharged on twelfth day following.

The upper half of kidney was normal in contour and aspect; the lower half was entirely replaced by a cystic tumor, which was roughly spherical but slightly elongated and measured 8 centimeters by 6 centimeters. The renal capsule was slightly thickened and adherent over the whole kidney, but especially where covering the tumor.

On section the upper pole of the kidney presented an essentially normal appearance with normal markings, except that there was moderate passive congestion. The tumor was not multilocular; but corresponded in appearance to an echinococcus cyst. The wall of the mother cyst was 1 millimeter thick; filled with numerous, probably 30, daughter cysts, varying in diameter from ½ to 2 centimeters, with typical thin, pearly white walls, all filled with aqueous fluid. The kidney cortex thinned out over the portion of cyst adjacent to the main mass of kidney. The renal pelvis was involved by a cyst at one point, a daughter cyst of about 1 centimeter diameter projecting into one of the calyces. The orifice of communication between the main cyst was 0.5 centimeter in diameter. The relation of tumor to cortex, the latter thinning out gradually over the former, indicated plainly that the tumor originated in the midst of the lower pole and expanded gradually, giving rise to a pressure atrophy, with, finally, almost complete disappearance of lower half of kidney. The invasion of the pelvis was undoubtedly late and secondary.

A. L. Stavely's Case

Male, age 43, Russian Pole, admitted to hospital March 5, 1889, with intense pain anteriorly, just below the thorax and extending around to the back.

Examination showed patient well preserved, with a very marked prominence of the lower part of thorax and upper part of abdomen. On palpation a large, firm mass could be felt extending about 4 inches below the margin of the ribs. The urine was slightly darker than normal with no albumin or anything else that could be of assistance in making a diagnosis. No jaundice. On April 11, he suffered excruciating pain requiring frequent hypodermics. April 12 he dropped dead on the floor.

Autopsy. On opening the abdomen a large, tense, fibrous sac was seen and found to have liquid contents. All the organs were displaced by it. On feeling for the right kidney, it was discovered that its position was occupied by this enormous body and the kidney could not be found. In trying to remove the cyst, the finger forced its way through a weak spot and more than nine pints of a clear odorless, serous-like fluid escaped; floating in the fluid was found a solitary daughter cyst about 0.5 inch in diameter. The cyst was removed after great difficulty and found to contain a thick, white membranous mass floating in some liquid. The membrane, or more properly the cyst wall, was distinctly laminated and looked something like boiled albumin. One surface, slightly roughened, had here and there an aggregated nodular mass which proved to be echinococci buds. The other surface of the cyst-wall was smoother, covered with thin layers of a jelly-

like consistency, easily detached, and appeared to be of more recent formation.

Microscopic examination of the fluid showed a number of hooklets and crystals of sodium chlorid.

No apparent lesions were found in any other organ except that the heart was somewhat dilated, with some fibrinous deposit about the mitral and aortic semilunar valves.

Report of 3 Cases by Edward L. Young

Case 1. Male, age 34, Italian. Family and personal history were negative. Six weeks ago patient began to have a heavy feeling in the epigastrium; most marked after eating and decreased in intensity until next meal. Ten days ago this feeling changed into a pain confined to the epigastrium. Five days ago the pain became worse, confining the patient to bed. One month ago he had some burning micturition but no hæmaturia or other urinary symptoms. No nausea, vomiting or chills.

Examination was negative except for marked tenderness and muscle spasm in epigastrium, most marked 2 inches above umbilicus. No spasm was present in lower half of the abdomen, which was soft but tender.

Immediate operation. Abdominal incision: nothing intraperitoneal but a mass about the right kidney. A kidney incision was then made and the kidney found to be a large cyst, the cavity extending about 4 inches into the liver. The kidney was removed and the cavity washed out. The wound was drained. Convalescence was normal.

One month after operation echinococcus fixation test was positive.

Case 2. Male, age 23, Italian. Family history negative.

Personal history was negative. As a boy he played a great deal with his dog and was in the habit of sleeping with it. Two years ago he passed one small, colorless bean-like body in urine, accompanied by pain and blood. He felt perfectly well afterward. Five months later he had a similar attack passing several cyst-like bodies; since then he has attacks every 3 to 5 months.

Examination was negative except for the fact that the spleen was easily felt. The patient brought in two unruptured cysts which proved to be broad capsules from an echinococcus cyst. Cystoscopy showed bladder normal and both ureters were easily catheterized; flow of clear urine from each. An intravenous phenolsulphonepthalein test was made and showed an output of 50 per cent in 15 minutes from the right side; 4 per cent from the left side. Cultures from both sides showed no infection. X-rays were negative. Injected X-rays showed an abnormal pelvis. Complement-fixation test for echinococcus positive.

Nephrectomy with normal convalescence; 4 days later fixation test moderately positive; 26 days later fixation test negative.

Case 3. Male, nationality not stated, was transferred from medical service to surgical service with a diagnosis of retroperitoneal tumor. Family and personal history were negative. Patient had pain in upper left quadrant 15 years ago when he noticed a mass. This mass grew slowly until 2 months ago; since then the increase has been very rapid. He has cutting pain in the left upper quadrant, radiating down into thigh. He has been vomiting about twice a week for past month.

Examination was negative except for a rounded tumor filling the left abdomen, extending to the umbilicus on the side and half-way to pubes below. The surface is irregular, and the mass moves with respiration.

Urinalysis: Acid, specific gravity, 1,028; trace of albumin; rare cast; leucocytes and red blood cells present. Wassermann negative. Guaiac on stools, positive. Renal function 15 per cent in first hour. Cystoscopy: normal urine from each side with equal normal function.

Operation. A tumor was found attached to the kidney; nephrectomy. Normal convalescence. Ten and thirty-five days later fixation tests were still strongly positive.

Pathologist's report. The specimen consists of a kidney containing an elongated tongue-shaped mass, measuring 8 by 18 centimeters, attached to one pole. The surface is fibrous and fatty and on section is filled with echinococcus vesicles. Its base is formed by a portion of the kidney cortex, which is completely walled off from the rest of the kidney substance. The rest of the kidney shows nothing noteworthy.

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A HITHERTO UNRECOGNIZED MODE OF ORIGIN OF CONGENITAL RENAL CYSTS[1]

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SPACE does not permit a review of the abundant literature on congenital renal cysts, a condition with which every medical man is more or less familiar. Suffice it to enumerate here the several possible modes of origin which have been suggested by previous authors: (1) the persistence of the "anlagen" or rudiments of uriniferous tubules in the vesicular phase of development and their later expansion; (2) the failure of the S-shaped anlagen of uriniferous tubules to unite with the straight collecting ducts; (3) the failure of uriniferous tubules to join the collecting ducts of higher orders (later generations) after having become detached from such ducts of a lower order; (4) the belated appearance of disconnected cavities in a uriniferous tubule which had remained solid during its formation; (5) the secondary compression of collecting or secretory tubules due to a local inflammatory process, as congenital syphilis, for instance, or other pathological changes. The production of retention cysts by the latter method has been demonstrated sufficiently clearly to occur, but the other possibilities are in the nature of hypotheses, which can neither be denied, since theoretically they are entirely plausible, nor have they been adequately proven. On the other hand, the following observations reveal a process of cyst formation heretofore unrecognized, and the writer's interpretations have the advantage of being based on a series of consecutive embryonic and fœtal stages displaying all steps in the genesis of such cysts and their derivation from an originally normal physiological condition.

Regarding the development of the functional kidney or metanephros, it will be recalled that it has a double origin, the ureter, renal pelvis, calyces, and straight collecting tubules or ducts arising from the so-called ureteric bud, a diverticulum of the more primitive wolffian duct, and the coiled uriniferous or secretory tubules "crystallizing" so to speak, from the metanephrogenic blastema into which the ureteric bud grows. The blind expanded end of the bud becoming the primitive renal pelvis, it now gives rise by sprouting, branching, and rebranching to the different successive generations or orders of straight collecting ducts. During this process, the metanephric blastema, which always caps the ampullæ or blind terminations of the last ducts formed, is divided in such a way that one part is raised or carried peripherally by the newly sprouting ones while the other part stays behind in the form of separate masses which lie in contact with the sides of the parent ducts. As this process is repeated every time a new generation of ducts is produced, generation after generation of potential uriniferous tubules are likewise laid down and accordingly arranged in successive tiers as one proceeds from center to periphery. Soon after those metanephric masses are split off from the blastema, they round out to form what are known as "metanephric spheres." By the acquisition of a cavity they become converted into the "metanephric vesicles." By further growth and change, they attain the typical S-shaped stage, one end establishing continuity with the respective collecting duct, and the other forming the glomerular corpuscle. Continued growth, extension, convolution, and histological differentiation create the definitive characters of the uriniferous tubules. For the details of these genetic processes, as well as the formation of the renal lobules, pyramids, etc., the reader is referred to Keibel and Mall's *Embryology*, vol. ii.[2]

It is stated in embryological texts that the first formed uriniferous tubules open into collecting ducts of the fifth order, but after birth, all uriniferous tubules discharge into collecting ducts of the tenth or higher order. It is generally supposed that this shifting of relations during development is effected in two

[2] Manual of Human Embryology. Edited by Franklin P. Mall and Alfred Keibel. Philadelphia: Lippincott Co., 1910.

[1] The present study is based on the microscopic examination and study of 26 human embryos and fœtus ranging in age from 6 weeks to 5 months, of more than 100 theoretical specimens examined of 12 babies and 36 cadavers in the dissecting room. Many of the embryos examined belong to the University of Chicago Embryological Collection at the Anatomical Laboratory.

Fig. 1. Photomicrographs of sections through the left (*A*) and right (*B*) kidneys of a 6 weeks' human embryo (17 millimeters). X60. *vert.*, Vertebral column; *ao.*, aorta; *v. pc.*, postcardinal vein; *mes.*, mesonephros; *T. I*, metanephric islands and strands, the rudiments of the vestigial primary generation of uriniferous tubules; *T. II*, anlagen of the secondary uriniferous tubules; *D. I*, and *D. II*, primary and secondary collecting ducts; *ren. p.*, renal pelvis.

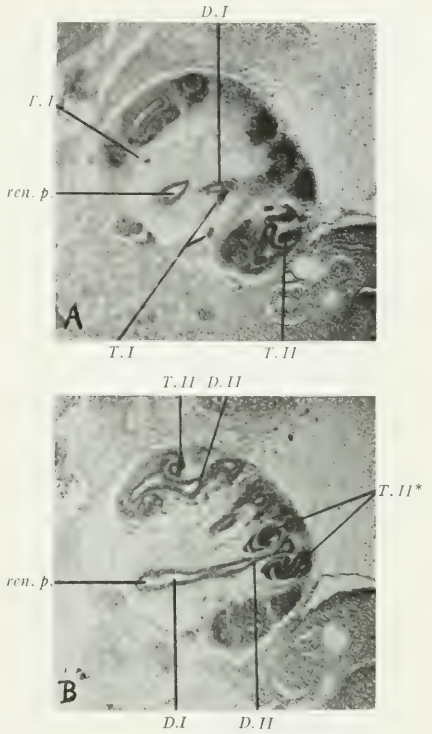

Fig. 2. Photomicrographs of sections through the left kidney of a 6½ weeks' human embryo (21 millimeters). X60. *T. I*, Metanephric islands or anlagen of the vestigial primary tubules, one adhering to primary duct, *D. I*; *T. II*, secondary tubules in vesicular stage; *T. II**, these tubules in S-shaped stage. Other references as in Figure 1.

ways: (1) by the temporary detachment of a uriniferous tubule from a collecting duct of a lower order and its reunion with a duct of a higher order, and (2) by the peripheral migration of points of junction between uriniferous tubules and collecting ducts due to the progressive sprouting, outgrowth, and elongation of the latter. It is further tacitly assumed by most embryologists, anatomists, and pathologists that degeneration of uriniferous tubules does not normally occur during development.

During the past year, the writer has made several interesting and significant observations in the developing human kidney which have a direct clinical bearing. These can be enumerated as follows: (1) the existence of a vestigial

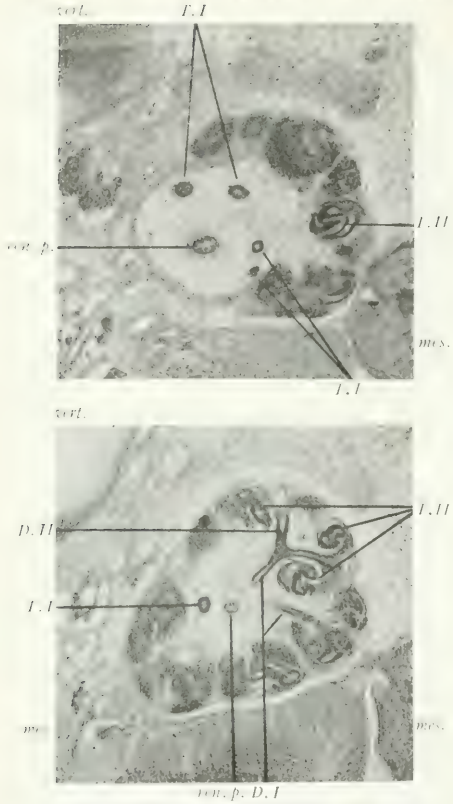

Fig. 3. Photomicrographs of sections through the left kidney of a 6-7 weeks' human embryo (22 millimeters). X60. *T. I*, Vestigial primary uriniferous tubules in vesicular stage; *T. II*, secondary uriniferous tubules. Other references as before.

Fig. 4. Photomicrograph of a section through the right kidney of a 7 weeks' human embryo (25 millimeters). X60. *T. I*, Solid rudiment of a vestigial primary uriniferous tubule; *T. II*, secondary uriniferous tubules; note the large glomeruli and the differences in staining reaction of the several portions of the tubules; *T. III*, tertiary uriniferous tubules in vesicular and S-shaped stages. Other references as before.

primary generation of uriniferous tubules; (2) the occasional cystic transformation of such vestigial tubules; (3) the early communication of the next or second order of uriniferous tubules (the first generation of previous authors) with collecting ducts of the corresponding order, namely the second; (4) the temporary detachment of most of these tubules from the secondary collecting ducts and their reunion with ducts of the fourth and fifth orders; (5) the later permanent separation of these uriniferous tubules from those ducts and the cystic transformation of most of them; in other words, the apparently constant appearance of renal cysts at a certain period of fœtal life. During this study, the writer focused his entire attention on the two generations of tubules mentioned, namely, the first or vestigial, and the second or first normally formed generations, the history and fate of which are discussed as briefly as possible in the succeeding paragraphs. It is probable that all or a large number of the tertiary uriniferous tubules meet with a fate similar to that of the preceding ones, although we have not brought together sufficient data to make decisive statements in this regard.

I. THE PRIMARY OR VESTIGIAL GENERATION OF URINIFEROUS TUBULES

At the time when the primary collecting ducts grow out from the primitive renal pelvis and drag or carry away from it the investing metanephrogenic blastema, small isolated fragments and strands of the latter tissues

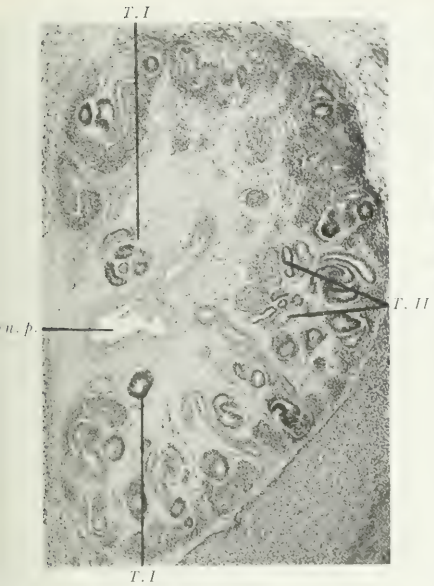

Fig. 5. Photomicrograph of a section through the left kidney of a 7½ weeks' human embryo (27.8 millimeters). X60. *T. I*, Vestigial primary uriniferous tubules, one in vesicular phase, the other tubular; *T. II*, examples of secondary tubules; note their large glomeruli. Other references as before.

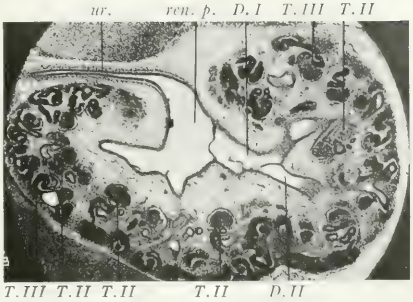

Fig. 6. Photomicrograph of a sagittal section through the left kidney of an 8 weeks' human embryo (29.2 millimeters). X30. *T. II*, Secondary uriniferous tubules; note their large size, especially of their glomeruli; *ur.*, ureter. Other references as before.

lag behind in the embryonic connective tissue near the renal pelvis. This becomes even more evident when the secondary collecting ducts bud from the primary ones. Such detached islands are especially clearly shown in Figure 1, A and B (*T. I*), representing the conditions in a 6 weeks' human embryo. Other particles of the blastema may adhere as spurs (*T. I*) to the wall of the primary collecting ducts (Fig. 2, A).

The majority of these centrally located and isolated islands of metanephric blastema round out and form at first dense solid spheres which become converted into vesicles, in approximately 7 weeks' embryos, as portrayed in Figure 3 (*T. I*). The manner of change from solid sphere to hollow vesicle compares closely with that of normally developing tubules, the peripheral cells of each anlage aligning themselves to form a typical columnar epithelium and leaving a clear lumen after the dissolution of the central core cells. As depicted in Figure 3, these isolated rudiments of potential uriniferous tubules (*T. I*) are medullary in position, the lightly staining mesenchyme of the medullary territory contrasting strongly both with them and the darkly staining cortex. The number of such vesicles belonging to this isolated primary generation is quite variable. In the particular specimen represented by Figure 3, there were eleven in the right kidney and sixteen in the left. Some of these may never get beyond the vesicular phase; the majority, however, continue to grow, elongate, and make a more or less successful attempt at tubular formation (*T. I*, Fig. 5). In this respect a striking difference obtains between this set of tubules and the ones coming after. Whereas the subsequent generations show a monotonous regularity and uniformity in the manner of development, it may be stated as a general rule for the generation under immediate consideration that no two tubules look exactly alike. Some may remain as vesicles during the remainder of their existence; others merely form a short curved segment; still others develop a simple coil without a glomerulus or with only a bare indication of it, while others again, more perfectly formed, may produce such structures, in some cases quite large, in others puny. All such observations indicate that we are here

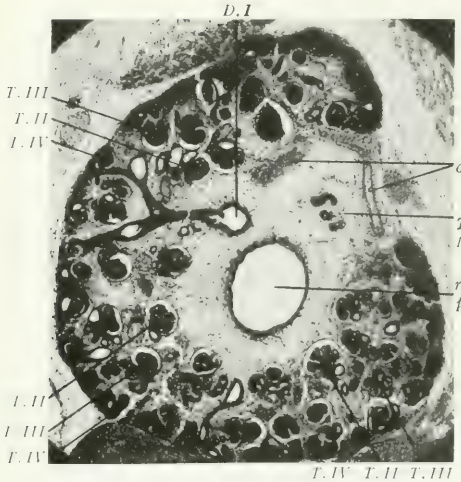

Fig. 7. Photomicrograph of a transverse section through the right kidney of a 9 weeks' human embryo (38.4 millimeters). X50. Note the arrangement in tiers of the uriniferous tubules of the first or vestigial (*T. I*), second (*T. II*), third (*T. III*) and fourth (*T. IV*) orders respectively; *ren. p.*, renal pelvis; *D. I*, primary collecting duct, showing its branching into the following generations of ducts; *arc.*, arcuate vessels.

dealing with an abortive attempt at tubular development. Moreover only two or three of the one hundred or more such tubules ex-

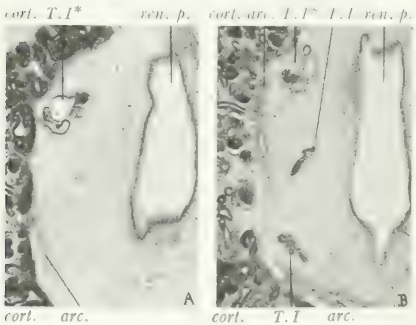

Fig. 8. Photomicrographs of pairs of sections (A and B) through the left kidney of a 9½ weeks' human fœtus (45? millimeters). X30. *T. I**, A vestigial primary uriniferous tubule in the initial stage of cystic development; *T. I*, other vestigial tubules; note their position between the arcuate vessels [illegible] and the renal pelvis [illegible] part of the renal cortex and its tubules.

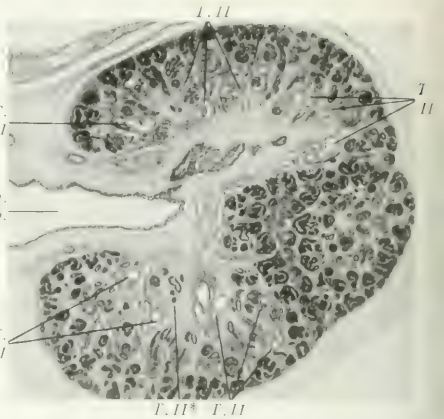

Fig. 9. Photomicrograph of a section through the left kidney of a 2½ months' human fœtus (55 millimeters). X25. *T. II*, Secondary uriniferous tubules in the initial stages of cystic degeneration; *T. II**, a secondary uriniferous tubule degenerating without cystic formation. Other references as before.

amined gave evidence of any histological differentiation, that is, of possessing, besides glomeruli, cellular differences in the several tubular segments. Finally, only one of these tubules had succeeded in making a connection with the collecting system of ducts by joining the renal pelvis by means of a slender, solid, intermediate piece. All the others remained isolated.

The above characteristics clearly demonstrate the vestigial nature of these tubules. Such proof may be briefly recapitulated as follows: (1) the great numerical variability of the anlagen laid down, (2) the stunted appearance of many of the resulting tubules, (3) their lack of histological differentiation, (4) the failure to unite with the collecting ducts. Furthermore, we can maintain that this vestigial generation of tubules in reality represents the primary one, as expressed by the intimate association of some of their earliest anlagen with the primary collecting ducts.

During their entire history, the vestigial tubules are situated in the medullary zone, that is central to the arcuate vessels as shown in Figures 3 to 8. They frequently lie close

Fig. 10. Photomicrograph of a section through the right kidney of a 3 months' human fœtus (70 millimeters). X25. *T. II**, Two cystic uriniferous tubules of second order; *T. II*, other tubules of this order much enlarged and some in the early cystic stages. Other references as before.

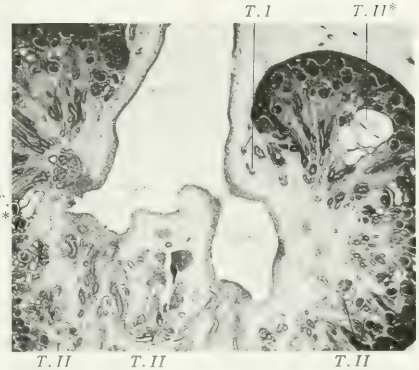

Fig. 11. Photomicrograph of part of a section through the left kidney of a 3½ months' human fœtus (87 millimeters). X20. *T. I*, A vestigial primary uriniferous tubule with a puny atrophic glomerulus; *T. II**, cystic secondary uriniferous tubules; *T. II*, other tubules much enlarged and some in initial cystic stage; *dyx.*, major calyx (former primary collecting ducts) showing entrance of papillary ducts. Other references as before.

to the epithelial lining of the renal pelvis or the major calyces (former primary collecting ducts). A favorite site is the mouth of the renal hilus (*T. I*, Figures 7 and 11).[1]

That such primary uriniferous tubules never become functional in man has been definitely established. At what time, however, they disappear and how they disappear is a problem which can be solved only by a careful scrutiny of late fœtal and postfœtal stages. When the writer studied them in the 2 months' fœtus (Fig. 8), and noticed that they had apparently reached the end of progressive development, he fully expected to find them in all stages of retrogression and disintegration soon after. But in a 5 months' fœtus they are still present and, with the exception of the few that become excessively large and cystic, are not different, it seems, from those of preceding months. In the great majority of cases, no change, either progressive or regressive, is visible throughout a long period. Whether or not these tubules will vanish before the end of fœtal life, or persist as vestiges long after birth, remains an open question; it would not be a matter of surprise to find their epithelial rests in the medulla even of a full grown kidney.

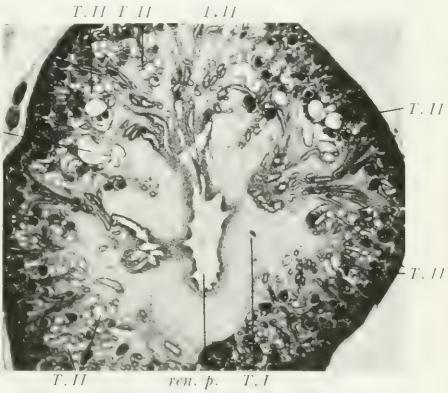

Fig. 12. Photomicrograph of a section through one of the poles of a kidney from a 3½ months' human fœtus (90 millimeters). X20. *T. I*, Vestigial primary uriniferous tubule; *T. II*, numerous secondary uriniferous tubules, some in initial stages, others in more advanced stages of cystic development. *T. II**, beginning collapse of a cystic tubule. Other references as before.

[1] When comparing the size of the uriniferous tubules of early and later stages of development as shown in the photomicrographs, it should be borne in mind that Figures 1 to 8 were taken at a magnification of X60, and Figures 9 to 14 at X25.

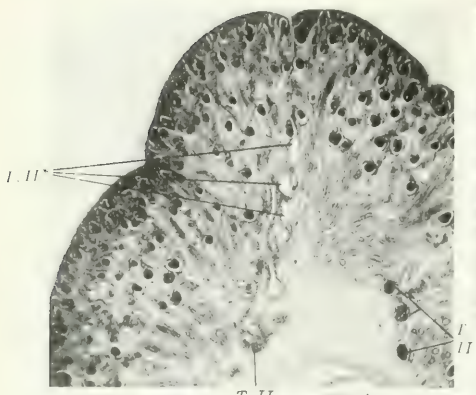

Fig. 13. Photomicrograph of part of a section of a kidney from a 5 months' human fœtus (140 millimeters). X25. *T. II**, Cystic secondary uriniferous tubule compressed by neighboring structures; *T. II*, other more centrally located uriniferous in initial stages of degeneration. Other references as before.

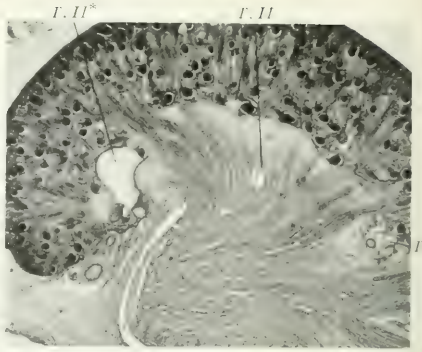

Fig. 14. Photomicrograph of part of a section of the left kidney from a 5 months' human fœtus (140 millimeters). X20. *T. II**, Large cystic uriniferous tubule, the one in the center of the picture showing a collapsed loop of Henle. Other references as before.

That these vestigial tubules may have an important clinical significance is shown by the discovery of their occasional cystic transformation. An initial stage in such modification is pictured in *T. I**, Figure 8, from a 2 months' human fœtus. Here a portion of the tubule is just beginning to distend. In another fœtus, one of 5 months, a later stage in the cystic development of one of these vestigial tubules occurred; it had become very much dilated and was situated near the renal pelvis between the apices of two neighboring renal pyramids. It is easily conceivable how not only a single renal cyst may be derived from it in a kidney otherwise normal, but by its further growth and pressure might readily become the starting point of a progressive formation of cysts involving the entire neighboring portion of the kidney.

II. CONCERNING THE URINIFEROUS TUBULES OF THE SECOND ORDER

In origin, development of form, growth, and early histological differentiation, the uriniferous tubules of the second order show notable precocity. The first ones of these, laid down as metanephric spheres in a 6 weeks' embryo (*T. II*, Fig. 1, A), already have attained the convoluted tubular phase and exhibit segmental histological differences in a 7 to 8 weeks' embryo, as depicted in Figures 4 and 5 (*T. II*) where differences in staining reaction and size of cells already demarcate the several tubular portions. Arising later than the primary or vestigial tubules, these secondary ones may already have acquired such relatively advanced characteristics at a time when the former are just beginning to change from the vesicular to the tubular form. It is true, the discrepancy in the comparative degree of development is partly accounted for by the developmental retardation of the atrophic or vestigial generation, but even when compared with the third order of secretory tubules, the second manifest precocity. In a 7 weeks' embryo, some of the tertiary tubules exist as spheres, but well differentiated tubules of this generation are found for the first time in 9 weeks' embryos.

In contradistinction to the primary or vestigial tubules, each of which differs more or less from every other, the secondary ones for some time show, as already pointed out, a remarkable developmental uniformity not only among themselves but also when compared with the subsequent generations of uriniferous tubules. Their progressive development through the sphere (*T. II*, Fig. 1),

vesicle (Fig. 2), S-shaped (Figs. 2 and 3) and several convoluted stages (Figs. 4 and 7) is a process with which every one is familiar who has acquainted himself, even only superficially, with the embryology of the kidney. Therefore, such a narrative would be superfluous here; for a description of this process, the reader may turn to Keibel and Mall's *Embryology*, vol. ii. But there are two or three features in their genetic history which should be delineated here. In the first place a large number of these secondary tubules, while in the S-shaped stage, temporarily join the collecting ducts of the same order, the second, as portrayed in Figure 2, B (*T. II*). Soon after, most of them develop a small diverticulum at the junction of the intermediate piece (the segment that joins the tubule to the collecting duct) and the potential convoluted segment. This diverticulum grows longer and peripheralward as a slender epithelial cord, and in somewhat later stages unites with a collecting duct of the fourth or fifth order. In the meantime the earlier connection with the duct of the second order is lost. But not all of these tubules behave thus; some retain their original connections until they disappear, for even in 4 to 5 months' fœtus, one observes at times shrunken and atrophic tubules attached to certain collecting ducts just above their opening into the major renal calyces, the former primary collecting ducts.

Another fact should receive particular comment, namely the early excessive growth of the great majority of the secondary uriniferous tubules, especially of their malpighian corpuscles and tubuli contorti. Their progress in this respect is startling, as illustrated in Figures 2 to 7. As actual measurements reveal, an embryo only 2 months old already possesses glomeruli which are equal in size to the largest found in a child of 2 years; in other words, a newborn babe does not have as large glomeruli as a 2 months' embryo. What causes the precocious enlargement of the earlier uriniferous tubules is obscure.

The further increase in size of these enlarged secondary uriniferous tubules is accompanied by certain degenerative manifestations, the inception of which is already unmistakable in a 2½ months' fœtus, as shown in Figure 9 (*T. II*). Here the tubuli contorti are much wider than formerly, and the proximal portions of the intermediate pieces have become considerably distended. These features give the first hint that these secondary uriniferous tubules will degenerate through cystic transformation. As yet, however, there is no indication of dilatation of Bowman's capsule. But all the tubules examined had lost their connections with the collecting ducts, although the remnants of such connections were sometimes visible.

In a later period in 3 to 5 months' fœtus, the cystic distention commenced in the intermediate piece progresses until the whole tubule is involved, as illustrated in Figure 10 (*T. II**). Bowman's capsule also becoming dilated, the glomerulus assumes a more or less flattened form and projects into its cavity as several separate tufts (Fig. 10). As the expansion of the remaining portions of the tubule proceeds, their epithelial lining also becomes more and more compressed and squamous in character. The lumen of such cystic tubules, even in the initial stages of distention, always contains a colloid-like substance of yellowish color, which during fixation contracts and pulls away from one side of the walls. It is shown in the photographs as faint shadows only partially filling the cavities of the cysts. Whether it signifies a product of the disintegrating epithelium or the excretion of a partly functioning but blind tubule, we are unable to say, although the latter possibility seems the more plausible.

The discovery of the large number of uriniferous tubules that normally are subject to cystic degeneration caused considerable astonishment on the part of the writer. For instance, in the 3 months' fœtus studied, approximately forty cystic tubules were counted in each kidney! In the 2½ and 3½ months' fœtus ten or a dozen were found. More fœtus of similar age must be examined before it is possible to state definitely when the numerical height of cystic development is normally reached, but the writer's observations would seem to indicate that this takes place at the end of the third or the beginning of the fourth month of intra-uterine life.

Although the cysts are formed more often between the medullary rays of the developing pyramids, as depicted in Figures 10, 11, 12, and 14, they may also occur in the renal columns of Bertini nearer the renal pelvis. The size which the cysts attain is quite variable. Some may show signs of collapse quite early (*T. II**, Fig. 12), while others may continue to grow very large (*T. II**, Fig. 14). If the cysts disappear as they usually do, this may happen in various ways. The degenerating epithelium may collapse or shrink away from the surrounding mesenchyme, as seen (*T. II**) in Figure 12. Consequently spaces are frequently found which contain in their lumen spurs or vestiges of the former epithelium. In other cases, the walls may not collapse, but the cyst becomes progressively compressed by the growth and crowding of the normal structures on both sides of it (*T. II**, Fig. 13).

The above observations indicate *that every human individual during his fœtal life normally passes through a period characterized by the presence of numerous cystic renal tubules*. Such a normal physiological event, however, may be converted into an abnormal or pathological condition if such tubules do not give way at the end of their allotted time but continue to grow (Fig. 14) and expand to the detriment of adjacent normal structures. Should one do this, it is readily understood how it may produce a large renal cyst, so frequently found in postmortem examination of the kidneys of infants as well as adults. During the past academic year, the writer inspected the kidneys of 36 cadavers in the dissecting room, and in five of them observed one or two renal cysts varying in diameter from 5 centimeters to 2.5 centimeters. He also made postmortem examination of ten babies, ranging from fœtus near term to infants several months old, and found in a newborn one kidney which contained several small cortical cysts measuring from 1 to 2 millimeters across. It has always been maintained that such cysts had their beginning either from an anlage of a uriniferous tubule which had failed to unite with its collecting duct, or resulted after a localized inflammatory process had obliterated a segment of a tubule or duct. The potency of such possibilities is not disputed, but in view of the normal physiological occurrence of the very numerous cystic tubules during a certain period of fœtal life of every individual, as described above, it is more reasonable to assume that more often renal cysts are produced by the persistence and expansion of cystic tubules which had failed to collapse.

It is also conceivable how not only isolated renal cysts, but also congenital cystic kidneys, where the entire organ is affected, a condition not at all infrequent, might have their inception in the cystic degeneration of the uriniferous tubules herein described. At least, a picture like that in Figure 12 is very suggestive. Should all the tubules (*T. II*) which have entered the initial phases in cystic formation continue to grow and distend at the same time, the increasing pressure upon the neighboring normal tubules would interfere with their normal genetic course and confluences and accordingly subject a greater number of them to the same alteration until the entire or greater part of the kidney is affected.

Which factor controls the normal degeneration and suppression of redundant structures is obscure. That such a factor exists seems to be indicated by the fact that the abnormal growth of some structures which should normally disappear, or undergo reduction, or at any rate remain passive, may not only occur in one but in several organs as witnessed by the frequent association in the same individual of renal, hepatic, pancreatic, or genital cysts.

UTERINE SECRETION—AN EXPERIMENTAL INVESTIGATION INTO ITS EFFECT UPON COAGULATION OF THE BLOOD[1]

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ONE of the most important problems confronting the gynecologist is that of functional or essential uterine bleeding, a name given to that type of abnormal bleeding for which we have as yet found no definite etiological factor. It is quite obvious that before we can explain this pathological condition, we must first know the cause and the mechanism of normal uterine bleeding or menstruation.

The most striking feature in normal menstruation is the phenomenon of a uterine hæmorrhage that runs a strictly limited course in spite of the apparent incoagulability of the menstrual blood. Some investigators, among whom may be cited Blair Bell (1), believe that the absence of fibrin ferment is responsible for this phenomenon. Cristea and Denk (2) claim that the normal fibrin ferment resident in body blood is abstracted therefrom by the uterine mucosa. Schickele (3) showed that uterine extract retards the coagulation of blood. Similar experiments performed by Blair Bell led that investigator to conclude that the extracts obtained from uterine mucosa and from whole uterus did not interfere with the coagulation of blood. Dienst (4) holds that the responsible factor in the non-coagulability of menstrual blood is the anti-thrombin formed by the uterine mucosa. This, he explains, neutralizes the action of the fibrin ferment and thus prevents clotting. On this same basis he explains excessive bleeding as due to an excess of anti-thrombin. Whitehouse (5) in a series of careful and thorough clinical tests and observations, found that clotting always occurs in the uterine cavity containing normal endometrium. His investigations failed to show any excess of anti-thrombin in the menstrual blood or in the endometrium. He explains the presence of fluid blood in the vagina as due to autolysis of the uterine blood clot during its passage downward, as the resultant activity of a fibrinolytic or thrombolytic enzyme. In a bio-chemical investigation of the uterine mucosa, Halban and Frankl (6) found that when pieces of blood free endometrium or emulsions of blood free endometrium were added to serum plates or to milk agar plates, digestion of the proteid constituents of these culture media occurred. They found this tryptic ferment invariably present in the mucous membrane of the uterus (human) during the premenstrual period, frequently in the interval period, and only when pathological conditions were present, did they find this ferment in the postmenstrual period. As far back as 1898, Bond (7) showed that in animals, the uterus had a definite distinct secretion.

In a series of preliminary experiments with human endometrium, the writer tested the effects of the extract upon coagulation of human blood. Extracts made with saline solution and with distilled water were employed. The results obtained were inconstant and contradictory, due in all probability to the presence of both blood and tissue juices. Stimulated by the work of Bond, the writer decided to approach the problem from the animal experimental side to determine its effect upon the coagulation of blood as a step in the solution of the problem of pathological uterine hæmorrhage.

In this study, eighteen young female rats were used. The technique pursued was quite simple. A median suprapubic incision was made, exposing the uterus. In one-half of the animals, a silk ligature was tied around the uterus below its bifurcation; in the other half, the ligature was placed around one horn of the uterus just above the bifurcation. After a period of 2 weeks a second laparotomy was performed and the uterus was examined. In a number of instances this period was not long enough for a sufficient amount of secretion to accumulate. In these cases, the animal was again examined within 1 to 3 weeks. In some animals the uterine secretion was ex-

[1] From Columbia University, Institute of Cancer Research, F. C. Wood, Director.

TABLE I.—SUMMARY OF RESULTS OBTAINED IN EXPERIMENTS

Rat No.	Control Blood: Coag. Time Minutes	Control Blood: Incubation	Blood and Uterine Secretion: Coag. Time Minutes	Blood and Uterine Secretion: Incubation	Days Post Operation	
A′	4	Solid clot	2	Completely dissolved	8	Clear
A′	3	Solid clot	2	Completely dissolved	9	Clear
A′	3	Solid clot	1	Completely dissolved	13	Blood
A′	3	Solid clot	1	Completely dissolved	34	Clear
A′	2	Solid clot	6	Completely dissolved	51	Blood
B′		Solid clot		Completely dissolved	7	Clear
B′	3	Solid clot	2	Completely dissolved	30	Purulent
D′	4	Solid clot	4	Completely dissolved	18	Clear
D′		Solid clot	3	Completely dissolved	76	Clear
E′		Solid clot	3	Completely dissolved	28	Clear
E′		Solid clot	3	Completely dissolved	28	Clear
F′		Solid clot	3	Completely dissolved	80	Clear
F′	2	Solid clot	2	Completely dissolved	80	Clear
F′	3	Solid clot	2	Completely dissolved	32	Blood
M	3	Solid clot	8	Completely dissolved	93	Clear
N′	3	Solid clot	5	Completely dissolved	98	Blood
O′	3	Solid clot		*Partly dissolved	78	Clear
R′	3	Solid clot	3	**Partly dissolved	78	Clear

*About [illegible] **About one-half.

N. B.—Rat [illegible] died.

amined as many as two and three times on separate occasions. In the successful cases, there was readily seen a marked distention of the uterus—either complete or half, depending upon the location of the ligature. In most of the animals, the distention was produced by a clear opalescent fluid. In three the fluid was distinctly blood-tinged and dark and smoky looking in appearance. In another, the fluid in one horn of the uterus was frankly purulent. In the non-successful cases, there was no distention of the uterus and no apparent change in its appearance. In two of the animals, O′ and R′, the uterine distention was extremely slight and the quantity of fluid obtained very small. By means of a fine aspirating needle, the secretion was removed from the uterus and one-half to one cubic centimeter poured into a test tube. Blood was now taken directly from the heart of the same animal or from that of another rat of the same breed. Later on in the course of the experiments, blood from guinea pigs and human blood were employed, and the results obtained were uniformly similar. As soon as the blood was obtained, one-half was added to the uterine secretion and the remainder was used as a control. The coagulation time was now recorded. The blood was considered fully coagulated when the fluid within the test tube was completely solidified as shown by holding the tube upside down. After coagulation had taken place, both test tubes were put into the incubator and examined on the following day.

From the data as given in Table I, it is readily seen that in every instance except O′ and R′, the two cases mentioned above, there occurred (1) a distinct interference with the coagulation of the blood as is evidenced by an increase in the coagulation time, (2) a complete fluidification of the blood-clot in all the specimens containing uterine secretion. It is most interesting to note that at the third laparotomy in rat A′, made 51 days after the primary operation, the right half of the uterus was distended with bloody secretion and the left half with clear secretion. The amount of fluid in the right horn was so great that part of it was tested against human blood. As noted in Table I, the addition of this secretion to the human blood increased the coagulation time from 2 minutes to 8 minutes. Another point of interest in this animal consists in the fact that 15 minutes after coagulation had occurred in the blood and secretion mixture, it was noticed that complete fluidification of the clot had taken place.

From these experiments, one is justified in concluding that the uterine secretion in rats contains a substance or substances that have the power of delaying coagulation time and of dissolving blood clots. As for those instances where the uterine secretion contained blood, the writer offers two possible explanations: (1) injury to the blood vessels during the ligation of the uterus resulting in an intra-uterine hæmorrhage; (2) digestion of the superficial endometrial blood vessels by the proteolytic ferment with resultant hæmorrhage. The latter is in line with the theory as advanced by Halban and Frankl (6). These authors maintain that the tryptic ferment of the endometrium by its digestive action causes (1) the decidual swelling of the stroma cells; (2) the destruction of the superficial epithelium; and (3) the erosion of the superficial endometrial vessels with the resultant flow.

Taken in conjunction with the work of Whitehouse, Halban and Frankl, etc., the results of these experiments justify the theory that the cause of abnormal uterine bleeding,

not accounted for on anatomical grounds, i.e., neoplasms, etc., lies in a deviation from the normal physiology of the secretion formed in and by the uterine mucosa. That this in turn is controlled by the ovary either in whole or in conjunction with other glands of internal secretion is most likely the case, and by definite advances in our knowledge of the physiology of these organs will we be able to solve this problem and others associated with it.

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THE SURGICAL IMPORTANCE OF IODINE IDIOSYNCRASY AND POISONING

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IODINE is a disinfectant for skin and open wounds commonly used by the laity and the medical profession. In rare instances, a patient may have an idiosyncrasy for the drug and its use produces symptoms varying from a local lesion to death. Recently at the Massachusetts General Hospital I observed a fatal case, and it seems to me worth reporting with a survey of the literature.

Idiosyncrasy, or allergy, is a familiar term which we can define for this paper as the production of symptoms analogous to the toxic symptoms of iodine, caused by such doses of the drug as are usually considered harmless. The word iodism is also used by various writers almost synonymously with allergy.

LITERATURE

Reports in the literature are largely of cases resulting from the ingestion of iodides, with rare cases of iodine used externally. Most papers date from 1850 to 1900 although we are told Coindet (5) first used iodine as a therapeutic agent in 1820 and that Ricord in 1839 mentioned cutaneous eruptions from potassium iodide and in 1842 saw the same drug produce "a veritable purpura hæmorrhagica" (19). Knowles (5) in 1910 divided the iodide cases into two provisional groups: (1) the extensive petechial hæmorrhagic, bullous cases occurring in individuals with organic disease, chiefly of the heart or kidneys or with a lowered condition of the general economy making them more susceptible to the effect of the drug or with a story of idiosyncrasy to the same. (2) Those cases showing localized distribution of lesions occurring in patients in perfect health on occasions which can be explained only on the theory of mild idiosyncrasy. Sex and age have nothing to do with the occurrence. The physical reaction of the individual to the drug and not the quantity ingested decides the question.

PHARMACOLOGY AND PHYSIOLOGY

The action of iodine and its salts, the iodides, is essentially identical, Cushny (13) remarking: "Iodine is absorbed in the form of iodides and perhaps in combination with protein," and elsewhere: "In contact with the tissues, iodine and protein compounds result." The fate of iodine in the body is precisely similar to that of the iodides, and it is excreted in the form of iodides. Hence the literature of the iodides applies to iodine. This is not true of iodoform, the symptoms from which are in part dependent on the methyl group and therefore not within the scope of this paper.

Regarding the absorption of iodine, Peterson and Haines (1) state: "When applied by surgeons freely to absorbing surfaces, it (iodine) may cause systemic disturbances."

Likewise Cushny (13) says: "It (iodine) penetrates into the deeper layers of the skin and small quantities are absorbed" and idiosyncrasy gives symptoms after small doses. The choice of iodine as a disinfectant is due in part to this very penetrating power. Applied to mucous or serous surfaces it is more readily absorbed (13). If the drug is applied locally without incision we get absorption, but if an incision is present, absorption is greater because of the raw surface. That the symptoms are not due to an impurity of the drug is proved by reactions where a drug known to be pure was used (13). Iodine is a powerful counterirritant (17), and the physiology of its use is chiefly increased blood supply which in turn means increased removal of products from the part and greater absorption of the drug. The pathological changes in the skin (5) are noted in the immediate vicinity of the blood vessels and in the walls of the vessels themselves, the leucocytes playing a distinct rôle in the absorption of the drug.

Iodine is excreted (3) chiefly through the kidneys and the saliva but also through the stools (22), skin, and sweat glands (5). Ingested iodides have been eliminated as pure iodine by the gastric mucosa (14, 19, 21). Normally excretion is rapid.

HEREDITY

There are few recorded cases of allergy to the same drug in parent (9) and child as well as in sisters (8), in some present at birth, in others developing after periods of intermittent exposure to the drug. Regarding iodine, there is no literature to prove this is specifically true. Logically it might well be so.

CLASSIFICATION

Knowles' (5) satisfactory classification is based on whether the patient has organic disease or not. Personally I prefer to classify by symptomatology and divide the cases into two great classes: (1) systemic symptoms in varied severity, without skin symptoms; (2) cases with skin lesions, which we must subdivide into (*a*) local lesion with or without systemic symptoms; (*b*) acneiform type with or without general symptoms; (*c*) bullous type; (*d*) purpuric type.

DOSAGE REQUIRED

The literature is often indefinite and refers chiefly to the iodides. The consensus of opinion is that a very small dose can produce the reaction (11), and this makes the entry of a small amount through the skin a perfectly logical etiology for certain cases. The physical reaction to the drug and not the dose is the important factor (10). Peterson and Haines consider (1) 1 fluidram of the tincture of iodine the fatal dose; Cushny says (14) 0.20 grams is the quantity of iodine giving severe effect. The minor eruptions (4) are more frequent from smaller doses of 5 to 10 grains of the iodide, and they sometimes disappear when the dose is increased. In *industrial medicine* (26) ingestion of iodine fumes has caused typical chronic and acute poisoning.

SYMPTOMATOLOGY

Bastedo (4) very satisfactorily sums up untoward actions as:

1. Skin lesions, such as acne; urticaria; or vesicular, bullous, or hæmorrhagic bullous, or purpuric eruptions or disseminated bright or dusky red, painful nodules (6, 7, 4, 11).

2. Irritation of mucous membranes, the symptoms resembling a severe cold in the head or influenza, œdema of the glottis, and swelling and inflammation of the parotids.

3. Iodide fever, characterized by albuminuria in some cases, fever, and eventually delirium. One of his cases had a similar reaction a year previous following iodides. Konried reported two cases from local use of an ointment.

4. Chronic iodism.

MECHANISM OF THE IDIOSYNCRASY

Coca (8) maintains that the drug allergy or idiosyncrasy is not essentially different in underlying mechanism from idiosyncrasies to the non-medical substances. Iodine hypersensitiveness exists, it being exhibited to iodides. The allergy usually appears in a few hours after administration but may appear after intervals of 5 to 20 days following primary injection. Symptoms (14) may not occur on the first dose but later appear for no apparent reasons. The allergy (8) is specific for a drug or group of drugs. The whole explanation of idiosyncrasy is *sub judice*.

OPTIMUM CONDITIONS

Damage to the heart or the kidneys favors the reaction, really because injury to these organs means slow excretion. Similarly patients in poor general physical condition are more likely to show the symptoms. Then there are those who have a definite idiosyncrasy (15), either congenital or acquired (26). Just where to say a patient is simply poisoned by a quantity of the drug and where definite idiosyncrasy is to be blamed is a matter of degree, and I feel that except in large doses we must prefer the term idiosyncrasy, for the terms poisoning or iodism are looser and less accurate although somewhat synonymous. Any case giving toxic action from doses ordinarily considered safe should class as allergy.

TYPE CASES

Systemic type. The cases of Regnard and Simon (20) commented upon by Wood (19) showed definitely pathological urine with albumin, blood, and casts, autopsy disclosing hæmorrhage into the tubules, after external application of preparations containing iodine. Complete anuria may occur (22). Culpepper (23) described a case where 2 drams of some iodine preparation were applied to both legs of a child of 11 years for probable eczema. Local pain began at once, followed in 24 hours by headache, lumbar and general abdominal pain, and diarrhœa. The fæces gave positive iodine test with starch. The stools were almost pure blood the fifth day. The child died on the sixth day. The temperature was never over 98.0. Anuria and priapism existed for some days. The stools were dysenteric for the last 2 days of life. The intellect was clear to the last. Giddiness was felt on any movement. The lungs were resonant. In the severely toxic cases the application of iodine (1) has caused headache, dizziness, mental trouble, along with gastric symptoms such as pain, vomiting, purging, extreme thirst, fainting attacks, and collapse. The elimination by the kidneys involves that organ in inflammation.

Skin lesion. Perhaps the common iodine burn. Iodide rash occurs occasionally.

Skin lesion plus systemic symptoms. Rose's case (13) of poisoning from the injection of an ovarian cyst with iodine showed thirst, constant vomiting (the matter containing iodine), cyanosis and coldness of the skin, small weak pulse, anuria, and skin eruptions after a few days, death occurring on the tenth day. In such cases the mucous membrane of the stomach and intestine has been found swollen and in animals fatty degeneration of liver, kidneys, and heart are found. Rose's case closely resembles in symptoms the M. H. case described later in this paper.

The best authenticated case is that reported by Bryan (23, 24):

"A prostatectomy was done upon a man of 52 who had an idiosyncrasy for iodine poisoning. The abdomen was prepared as usual with iodine, for suprapubic drainage. He developed within 24 hours evidences of an acute intoxication, urticarial rash, cerebral upset, moderate anuria, and evidences of an intense intoxication. I was almost afraid at one time we would lose him. Subsequent history revealed the fact that infection of his arm had been treated with iodine. On one application his life was practically despaired of on account of a similar poisoning. It was the usual 50 per cent preparation of iodine that was used and it was the only instance I have had in a fair experience with such an idiosyncrasy."

Bullous type. This type is often combined with the purpuric type. Knowles (5) mentions a hæmorrhagic bullous type, the eruption being in several patients somewhat generalized on the face and extremities (particularly the arms); others mention the legs as being more commonly involved. Cases of extensive distribution of this type are frequently fatal, 7 out of 11 of the series ending fatally. Minot and Lee (15) observe that "Iodine is one of the drugs that most commonly produces purpura in man especially when the kidneys are injured. Purpura due to this cause tends to be characterized by hæmorrhagic blebs, especially about the fingers. Sutton (9) and Ormsby (10) mention iodine as a cause of skin lesions, the latter describing a fatal case with bullous eruption after ingestion of potassium iodide as reported by Hallopeau. Hyde (25) saw three similar cases with lesions on face, trunk, and limbs, all recovering.

Purpura. The previous type is very similar. Ormsby (11) believes: "A comparatively small dose of iodide may lead to extensive

purpuric rash. Pratt (12) says: "Iodine heads the long list of drugs that may, under exceptional circumstances, produce purpura, the iodides not doing so except in the presence of marked idiosyncrasy." He found not a single case of iodic purpura in 4 years' records in the Outpatient Department of the Massachusetts General Hospital nor did I have any greater success in going over all the house record cards there this year. All forms of drug purpura are rare. Pratt mentions a case at the Boston City Hospital given 180 grains of potassium iodide in 4 days. As a result the fingers were swollen and covered with large hæmorrhagic blebs. Lesions on the tip of the nose and over the thighs developed after 4 days. Osler's clinical records contain a case of acute febrile purpura (12 and 18) due to iodine, here showing an extensive urticarial rash associated with purpuric spots. Lesions of drug purpura are said to show greater tendency to become gangrenous than purpura from other sources. Stelwagon (7) notes that iodine has caused purpura fulminans which consisted of profound cutaneous disturbance, hæmorrhages from the mouth and stomach, intestinal symptoms, general symptoms of collapse, and rapidly fatal ending.

The following case from the Massachusetts General Hospital inspired this study and I report it through the kindness of Dr. Porter and Dr. Greenough.

W. S. 246437. A man of 55, white, married, manager by occupation, was admitted for gastric study with the additional diagnoses of left inguinal hernia and enlarged prostate. The family doctor knew of no previous iodine therapy. The family history was absolutely negative; no hæmophilia. Patient has a wife and 5 children living and well. One child died from peritonitis.

Past history. General health has been "tough and rugged." He had scarlet fever and whooping cough in childhood. He has had rare attacks of sore throat with cold. Cardiorespiratory and gastro-intestinal systems negative up to present illness. He urinated two to three times a day and sometimes twice at night. On two or three occasions the stream had stopped suddenly in the middle of urination, and there had been some loss of size and force of stream. Gonorrhœa was followed by gleet 33 years ago. The patient was told he had a stricture but he had no symptoms from, nor treatment of, the latter. He denied syphilis. He attributed loss of 25 pounds in weight in last year and half partly to overwork.

Present illness. He had gone downhill steadily during the past year. Eleven months before entry he first noticed a distressing faintness and dull epigastric pain 3 to 3½ hours after eating, usually about 10 a.m. and 3.30 p.m. These symptoms were at once relieved by food or soda and rarely appeared unless he was working hard. Six months before entry the man began to be nauseated and vomited with onset of symptoms. This relieved the pain. Vomiting was not constant but appeared for 2 to 3 weeks and then did not occur for some time. He had not vomited for 4 to 5 weeks until the day of entry. Symptoms were accompanied by a moderate amount of gaseous and sour eructations. At noon, 1 week before admission, after hard work, he had an onset of the usual epigastric pain which could not be relieved and which persisted on entry. This pain radiated to the back and was relieved in part by prone position. He vomited on the morning of entry. He had never been on a diet. He had never noted hæmatemesis, tarry or bloody stools, nor jaundice. He had never bled for an unusual time following an injury.

Physical examination showed a fairly well developed and nourished man, lying in bed. The skin was slightly sallow, soft, dry, clear, loose as if from moderate and recent emaciation. The head was negative except he had false upper teeth, fair lowers. No adenopathy. Expansion of the chest was equal. Lungs were resonant throughout with a few scattered, dry râles in the left back, just median to the upper scapula. Heart and pulse were normal. Abdomen was level, slightly tense, tympanitic, with an indefinite sense of fullness to palpation in the epigastrium suggesting mass. No spasm nor tenderness was elicited. No viscera were felt. The genitalia were negative. A small left inguinal hernia could be demonstrated. Multiple small scars were present on the lower third of the left leg, from old injuries. Reflexes were entirely normal. Rectal examination showed a tight sphincter with symmetrical, moderately enlarged prostate which a genito-urinary consultant later considered normal. Temperature, 99°–98°; pulse, 68–80; respiration, 20–24; blood pressure, 144–90.

Ward notes. November 18, day of admission: In bed, comfortable, with no symptoms. November 20: General appearance improved. Gastric test meal showed free and total acidity within normal limits; no gross, microscopic, nor occult blood in either meal. November 22: Gastro-intestinal X-rays negative and normal, both meal and enema. Blood Wassermann negative. November 23: Vomited with slight blood stain. November 24: Probable diagnosis of chronic appendicitis with hyperchlorhydria was made and operation advised.

November 28: Operation. Ether. Wide preparation with half-strength tincture of iodine. Exploratory laparotomy. Bassini repair of left inguinal hernia. Exploration and resuturing of abdominal wound for hæmorrhage. Patient was under ether from 10.40 a.m. to 1 p.m., the operations lasting from [illegible] to [illegible]. [illegible]

used. Pulse, 100–98; respiration, 24–22. The abdomen was opened through a 6-inch mid-rectus incision, considerable bleeding occurring from transverse bands. The gall-bladder was negative. Pylorus was felt; no induration in duodenum. No adhesions. The appendix retrocæcal with tip high in abdomen; removed, and pathological report normal. The wound was closed in layers after some difficulty in identifying the rectus sheath. Bassini repair of the hernia was done next. Hæmostasis throughout was unusually careful because of the trouble in the abdominal wound. After the herniotomy a large raised hæmatoma was noted in the abdominal wound, and this was opened after new table toilet and new local application of iodine. A bleeding point in the fat was tied with stitch-ligature and the wound reclosed. Plain catgut was used for small vessels, chromic for important vessels. Patient went to the ward in good shape.

During the afternoon and evening of the day of operation the pulse increased in rate with decreasing quality. No bleeding was seen, the resuturing of the wound having stopped this. At 3 p.m. the temperature was 101.6°; pulse, 140; and respiration, 25. Patient was not particularly restless. At 11 p.m. shock treatment was begun. November 29: Temperature, 101.2°; pulse, 134; respiration, 16 at 3 a.m., but condition was becoming worse and blood pressure fell to 50. Placed on the danger list at 8 a.m. Mentally alert. Transfusion was considered but he gained during the day, pulse being 100 and respiration 20 at 7 p.m. He was catheterized during the afternoon as he had not voided. This day's output of urine was 15 ounces in spite of a 50 ounce fluid intake. Blood pressure, 80–40. November 30: Continued improvement. Pulse 100 and fairly strong. The wound showed nothing but the remains of the hæmatoma. December 1: Improvement was so great that he was placed in the open ward. December 2: He was irrational during the night. Fair condition otherwise. Mentally alert. Pulse good. Fluids forced. December 3: Definite change for the worse. He was out of bed twice during the night, not well-oriented, and talking irrationally. Pulse was good but appearance worse. About this time the hernia wound, previously normal in appearance, began to assume a purplish color hitherto seen only in the rectus wound and from both wounds the coloration spread peripherally and continually, but slowly. Temperature, 99.2°–101.6°; pulse, 100–110. December 4: Transferred to a room and again placed on the danger list. He was much worse, irrational, fæcally incontinent, and this last condition persisted. On both lower limbs were a few hæmorrhagic blebs, first on the great toes, and then variously over the anterior aspects chiefly. A large hæmorrhagic bulla was seen on the dorsum of the left foot. In the afternoon his condition was so serious that he was given 500 cubic centimeters of whole blood intravenously. Pulse before and after was about 100. Temperature at 3 p.m. was 101°, at 11 p.m. after transfusion it was 98.8°. The arm was prepared with half-strength [tincture of] iodine, at once carefully removed with alcohol. December 5: Temperature rose from 99° in the morning to 101° at night; pulse, 100; respiration 25, rising to 35. Mentally he was much clearer. The purpuric spots in the rectus region had spread definitely during the past 2 days. A medical consultant said: "Condition suggests low grade infection, basis of blood clot. Probably not purpura due to iodine since no other iodized areas have shown trouble." In this connection we should notice that iodine at the transfusion was immediately and carefully removed with alcohol. About this time a small spot of half-strength tincture of iodine was painted over the mid-sternal region and at death and at necropsy this small spot showed a little purplish coloration. That night the patient was in fair condition, the effects of the transfusion persisting somewhat. Renal function 65 per cent. but 25 minutes overdue. The kidneys, therefore, seemed to be functioning fairly well at this time. The fluid chart is shown below. Stool was watery, dark brown, with definite blood. December 6: Very little change in the morning. Temperature, 101.6°; pulse, 120; respiration, 36, so that temperature, pulse, and respiration were rising. Patient was much weaker in the afternoon, but the pulse continued of fair quality, about 120. Facies was shrunken, depressed. Patient became semicomatose. Intravenous digitalis had no effect. Further transfusion was considered. The purplish blebs had extended more widely and most of the abdomen was purplish in color. December 7: The incontinence and irrational condition persisted. The patient became steadily worse and died. The addition to the bullæ and abdominal coloration, purple petechiæ were scattered over thorax and slightly on the face. Necropsy was obtained. Laboratory notes in addition to above showed the urine to be absolutely negative on November 20 and 30 and on December 1 and 5. November 24, stool negative, no blood; December 6, watery, brown, with definite blood. November 29, blood-clotting time was 6 minutes and 7½ minutes in 2 tubes. December 5, bleeding time was 6½ minutes. December 6, non-protein nitrogen of blood 33.6 milligrams per 100 cubic centimeters.

	Red count	Hæmoglobin	White count
November 29	4,800,000	70	7,200
November 30	2,950,000	60	. . .
December 4	1,800,000		. . .
December 4	1,900,000	40	36,000
December 6	3,020,000	60	21,400

Blood smears, November 29, showed polymorphonuclears, 65; mononuclears, 3; lymphocytes, 32; slight achromia. December 4: Polymorphonuclears, 70; mononuclears, 6; lymphocytes, 17; eosinophiles, 1; myelocytes, 5 per cent. Polychromatophilia and achromia; nucleated reds 6.5 per cent.

Fluid intake and output.

	Ounces in	Out		In	Out
November 29	50	15	December 3	60	.
November 30	95	58	December 4	60	.
December 1	95	70	December 5	70	. .
December 2	90	45			

Necropsy, December 7, No. 4270, 11¼ hours post-mortem. Anatomical diagnoses: Ulcer and adenocarcinoma of the stomach with hæmorrhage into the gastrointestinal tract. Metastases into the retroperitoneal lymph glands and vertebræ. Purpura hæmorrhagica. Anæmia. Operation wounds. Obsolete tuberculosis of a mesenteric gland. Slight chronic pleuritis.

The dead body of a white man, 55 years of age, 170 centimeters long, well developed and fairly nourished. The head was not examined. In the right cubital space there is a purplish blotch with a brown red spot. In left cubital space is a short sutured wound. The skin of the anterior thoracic wall shows several small, scattered, dark brownish-red crusts. The anterior abdominal wall, beginning on the right side at the costal border and extending down anteriorly and along the lateral aspect as far as the upper part of the right thigh shows numerous, discrete and confluent, dark purplish, irregular areas and streaks. This condition extends across the lower part of the anterior abdominal wall to the region of the left lower quadrant and the left lateral aspect. From there it extends down to the upper part of the left thigh and to the upper part of the scrotum and along the dorsum of the penis. On the left foot there are two blister-like collections of this bloody fluid. On the big toe of the right foot there is a similar blister. Over the left tibia, groups of old, flat, brownish areas. On the right side of the anterior abdominal wall there is a linear wound 9.5 centimeters long, closed with sutures. In the region of the left lower quadrant there is a wound 10.5 centimeters long. The purplish areas are strongly marked in the region of these wounds. The subcutaneous tissues in the region of the purple areas are infiltrated with a small amount of dark purplish blood and much thin blood clot. This extends down to the muscle tissues and in places infiltrates them. In the region of the wounds the condition is well marked. The muscles of the anterior thoracic wall are pale, negative. The subcutaneous tissues are infiltrated with a considerable amount of thin pale fluid. The peritoneal cavity contains no fluid. The appendix is represented by a securely ligated stump. In the region of the stump, the peritoneal tissues are infiltrated with blood-like material. Œsophagus is negative. The stomach contains a moderate amount of opaque, brownish-red fluid and mucus. The mucosa generally is negative but at a point about 4.5 centimeters above the pylorus and along the lesser curvature, the mucosa presents a loss of substance 3.5 centimeters across. The margins are rounded, fairly smooth, rather clean-cut, but descend to a fairly smooth, grayish base. The base shows in the region of its lower left quadrant, reddish staining within which rests a small dimple-like depression, to which a small mass of dark brownish-red blood clot is weakly adherent. On cross-section, the stomach wall, in the region of the base of the ulcer, is thickened 3 to 5 millimeters. The peritoneal surface is fairly smooth; negative. No change in the retroperitoneal glands of the region is made out. The small intestine contains a moderate amount of brownish paste, but no definite bloody material. The mucosa is negative. The large intestine contains much brownish to blackish-red, fæcal material. The mucosa is negative. In places along the mesenteric insertion of the small intestine, there are small, diffuse, hæmorrhagic areas and streaks. The mesenteric glands generally are negative. There is one fibrocalcareous stony hard gland 1 centimeter across. The retroperitoneal glands generally are negative except for two glands in the region of the head of the pancreas which are slightly enlarged and one of which shows a grayish section surface mottled with small brownish-red areas. Diaphragm extends to right, fourth interspace and left fifth rib. The diaphragm of the right side of the pleural cavity anteriorly shows small hæmorrhagic areas. In the right pleural cavity are a few cubic centimeters of a thin reddish-tinged fluid; in the left, 200 cubic centimeters of a similar fluid. On the right are old adhesions in the region of the apex and upper lobe; in left, none. The lungs show no areas of consolidation. The tissue of the upper lobes is pale, spongy, and yields a small amount of thin, pale, frothy fluid. The lower lobes are pale to dark reddish. The tissues yield a moderate amount of thin, pale, reddish, frothy fluid. The pericardium is negative. The heart weighs 295 grams. The myocardium is a little lax and pale brown red. The right cavity shows slight dilatation. The heart contains a very small amount of blood. The valves are negative. The coronaries are free and negative. The foramen ovale is closed. The great vessels are negative and contain but little blood. The liver and pancreas are negative. The spleen weighs 175 grams. The capsule is smooth, the tissue plump, dark to brownish-red, bloody, and somewhat mushy. There is one small accessory spleen. The kidneys combined weighed 338 grams. The capsules of both strip and the surfaces are pale and smooth. The tissue is of good consistency, the markings are retained, and the cortex measures 5 to 6 millimeters. On section the surfaces are pale and negative. In each pelvis there is a small amount of fluid blood. The mucosa is rather generally infiltrated with a smooth, thin layer of dark, brownish-red blood clot. The ureters are free. The mucosa is negative. The bladder is distended with thin, slightly rust colored urine. The mucosa is negative. The bone marrow of the lumbar vertebræ is rather pale. Microscopic examination is negative except in two sections from the ulcer which show chronic inflammation with endarteritis. In one there is atypicality of mucosal tubules but nothing definitely carcinomatous. Retroperitoneal lymph gland shows well marked carcinoma, with some papillary adenomatous characteristics. The tissue of vertebral marrow stains poorly but it seems clear that there is carcinomatous invasion of the tissue.

Our interest in this case must center in the purpura and its etiology in spite of other in-

teresting points. Unquestionably of Knowles' first class with lowered physical condition, the primary causative factor seems to be either low-grade clot infection or iodine. The bacterial theories of purpura (2) seem to refer chiefly to focal infection, but in this patient the rectus wound might have been the portal of entry for clot infection. However, nothing was found at necropsy to suggest infection. The white count and temperature might be accounted for by infection, by absorption of the blood clot, or can be satisfactorily explained on the iodine basis. That no excreta were tested for iodine is unfortunate, for a positive test would have been absolute proof of etiology. The partial anuria after operation is suggestive. The pathological picture of the kidneys is seen in iodine cases. It is interesting to speculate whether the gastric symptoms and pathology were not exaggerated by the iodine which has a known irritating effect on mucous membranes (13, 19, and 21). The fever is perfectly consistent. In fact there is no symptom nor finding in this case inconsistent with the picture of iodine purpura of a severe type. One particularly outstanding symptom is present, and this marks an iodine purpura, viz., the presence of hæmorrhagic blebs (15). Notice also that in this case iodine has been used on a patient in whom a marked and typical iodine reaction took place early. We need not account for the relapse any more than to say that the development of the purpura and its secondary symptoms continued and gradually killed the man in spite of treatment. A corroborative fact in diagnosis is that a slight reaction took place on a very small area painted purposely with iodine for test, the necropsy protocol describing skin lesions in the region. The bacterial theory would require cultural evidence as proof. It is not necessary to introduce other theories when we know the abdomen was painted and repainted with iodine which was not wholly removed until after operation and some of which undoubtedly remained the full 2 hours. Actually we have two surgical wounds, one reopened after fresh application of the drug. Within 12 hours after the application we have a very striking reaction amounting to collapse and perfectly consistent with the picture of iodine allergy. In fact it was remarked at the time of this collapse that the so-called shock was most peculiar and atypical, and had resulted from an operation not very prone to shock. An infection unless very virulent would seemingly take a longer time to develop. I therefore class this case with those of iodine etiology and this most surely would have to be thoroughly ruled out before another etiology could be advanced.

PROGNOSIS

This seems to depend chiefly on the severity of symptoms. In all the series the death rate is strikingly high, the largest series being over 50 per cent. In any case the prognosis is most serious and death not an unlikely outcome.

TREATMENT

There is no specific therapy. Starch is the classical antidote for iodine and can be given in solution in the stomach. The usual methods of increased elimination are logical in the average case and in the purpuric type, at least, transfusion is indicated, often more than once.

CONCLUSIONS

1. A very definite iodine allergy exists, closely related to, if not the same as, iodine poisoning and iodism and identical in toxicology with its salts, the iodides, to which iodine is converted on absorption.

2. Cases of allergy closely resemble in symptoms those of poisoning and may be considered practically the same clinically, the chief difference being the amount of iodine absorbed.

3. While the condition is undoubtedly rare, precautions indicated are careful history and reasonable effort to prevent absorption, confining the action of the iodine to a local one. Early removal by alcohol is excellent. The technique of painting a postoperative wound with iodine has unfortunate possibilities. In doubtful or suspicious cases, use some other disinfectant. The obsolete use of iodine in ovarian cysts needs only mention.

4. In postoperative cases showing suggestive symptoms, test for the drug and institute appropriate treatment, depending on extent and type of symptoms.

5. A possible danger exists in the frequent use of iodine by the laity for early sterilization of open wounds. In surgery of compound fractures the full strength solution should be used with discrimination. A careful inquiry into previous reaction helps avoid fatal accidents.

6. In cases with marked idiosyncrasy, even painting the skin with iodine may cause symptoms, small amounts causing the effect.

7. Transfusion, when used, should be repeated whenever the patient is losing ground. Once may not be sufficient.

8. Iodides are commonly used in the treatment of syphilis, and in operating on this class of patient or any patient previously treated with iodide, the previous reaction to the drug should be determined, before one uses iodine again.

9. In spite of the efficiency of certain iodine salts as injections for urological X-rays, we must recognize a theoretical danger in their use.

10. In industrial plants where iodine or its fumes have been present, the workmen have sometimes shown symptoms of acute or chronic poisoning. Treatment of their injuries with iodine must be potentially dangerous.

11. I do not feel that iodine should be discarded as a disinfectant. The removal of the drug by alcohol immediately after application is desirable, and to a large extent should prevent the accidents of which the history does not forewarn us.

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THE ASSOCIATION OF FŒTAL MONSTROSITIES AND DEFORMITIES WITH PLACENTA PRÆVIA

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MUCH has been written on placenta prævia and a still greater amount has been published on fœtal monstrosities, but no one has emphasized the association of these two conditions. In not one of the well-known textbooks in English, German, or French, is mention made of the combination, except in von Winckel's *Handbuch der Geburtshuelfe* (1), where two cases are cited (Hoenck and Lomer). The *Index Medicus* from the year 1879 to the present time contains only three case reports, as indicated by the title, of the association of placenta prævia and fœtal deformities. These were reported by J. Jaworski (2), O. F. Buell (3), and J. Ritchie (4). A fourth case was found in the *Zentralblatt fuer Gynaekologie* for 1893, but this is not listed in the *Index Medicus*. This report was made by Hoenck (5), and in the discussion of the case, Lomer (6) mentioned that he had had a similar one.

Despite the paucity of indexed literature on the association of fœtal deformities with placenta prævia, it is the belief of the writer that this association is not infrequent. In the first place, of the cases in which the combination is found, not many are reported. Secondly, of those reported, exceedingly few give any clue to the condition by the title of the report. To prove this latter point, the following cases found in the course of reading current medical literature may be presented. In the January number of the *Edinburgh Medical Journal* for 1922, Ballantyne (7) reports a case of anencephalus associated with placenta prævia, in a paper bearing the caption, "Cæsarean Section: Its Indications and Technique." The same author (8), in the *Edinburgh Obstetrical Society Transactions* for 1904, mentions another case of anencephaly occurring in a patient with placenta prævia. This case was reported in a communication entitled, "The Use of Bossi's Dilator in Eight Cases of Complicated Labour," another non-informing title. Ballantyne in a personal communication says: "I can assure you that I have not very rarely found anencephalus and other monstrosities associated with placenta prævia."

L. J. J. Commiskey (9) in a paper on "Fetal and Newborn Mortality," mentions the fact that among seven cases of placenta prævia, one was born with a congenital defect of the abdominal wall. When inquiry was made as to the exact deformity present, it was learned that the author had recently died and no information concerning the fœtal defect was obtainable.

At the January (1922) meeting of the Chicago Gynecological Society, H. F. Lewis (10) reported a few fœtal monsters and among them was a case of gastroschisis associated with placenta prævia.

W. Strakosch and H. E. Anders (11) in a paper entitled, "Beitrag zur Lehre von den Akardiern: Ueber einen Holoakardius eumorphus," mention that the case which they report was associated with a placenta prævia.

M. Arnold (12) in an article on the treatment of placenta prævia mentions that two of the babies in his series were hydrocephalic.

Stenzler (13) in a recent number of the *Zentralblatt fuer Gynaekologie* in a paper entitled, "Zur Kasuistik des Schiefhalses," reports a case of torticollis associated with placenta prævia. (Torticollis is a congenital deformity not always due to external pressure effects). Katz (14) in a later number of the same journal tells of a case of placenta prævia in which the child had a number of deformities, the most conspicuous being the absence of both radii.

Finally, another case which was reported but where no clue was given by the title, is the report of an iniencephalic monster associated with placenta prævia made by Lowther (15).

In addition to the above fifteen reported cases, I have cognizance of six unreported cases, including two of my own. Abstracts of these cases are as follows:

Case 1. (Dr. De Lee.) Mrs. F. H. S., a primipara, age 28, had a placenta prævia lateralis, and a classic cæsarean section was performed on September 28, 1912, by Dr. De Lee. The child weighed 2183 grams (4 pounds, 13 ounces), and had a marked cleft palate. This patient had a normal pregnancy 5 years later and was delivered by low forceps of a live, normal baby weighing 3345 grams (7 pounds 6 ounces).

Case 2. (Dr. H. J. Stewart.) Mrs. R. H. P., a tertipara, age 36, had one living child, normal in every respect, age 8. A second child, born in 1918, had a spina bifida and was operated upon for this condition but with fatal results a few months after birth. At the time of birth of this child, the placenta was adherent. The last pregnancy was complicated by uterine hæmorrhages which began in the third month. Near term, profuse hæmorrhages occurred and a cæsarean section was performed on April 6, 1921, by Dr. Stewart and a live baby was delivered; but it had a hydrocephalus and a spina bifida and died a few weeks after birth. The mother's recovery was uneventful.

Case 3. (Dr. F. H. Falls.) Mrs. J. J. M., No. 17158, a primipara, age 26, who had had a miscarriage in 1919, was admitted to the Chicago Lying-in Hospital on May 18, 1921, because of profuse uterine bleeding. The general physical examination was negative and the pelvic measurements were normal. The blood pressure was 108-60 and a catheterized specimen of urine showed a heavy precipitate of albumin, a few granular casts, pus cells and motile bacteria. A diagnosis of presentation and position could not be made. The presenting part was floating and the fœtal heart tones were regular. By rectal examination it was found that the cervix was not dilated and a boggy mass was felt in the lower uterine segment. A diagnosis of placenta prævia centralis was made and a classic cæsarean section was performed. On making the uterine incision, the fœtal viscera bulged out. The fœtus, which was about 35 weeks old, not only had an evisceration of all the abdominal contents, but also an anencephaly. In addition the following abnormalities were noted. The left eyeball was not distinguishable but seemed to be fused with a small amount of meningeal tissue present. There was a strand of skin running from the nose to the meningeal tissue and also a rudimentary right arm, seemingly arising under the sternum. On the left hand, the first two fingers were partially fused and shortened. The placenta, which was found implanted [illegible] infarcts. The puerperium was febrile and the patient left the hospital on the sixteenth day after operation.

Case 4. (Ward patient.) Mrs. S. U., No. 11421, age 26, an octipara, had a central placenta prævia, and a classic cæsarean section was performed by Dr. D. A. Horner on April 1, 1920. The baby had scleroderma neonatorum and died on the fourth day. The mother's recovery was uneventful.

Case 5. (Author's first case.) Mrs. C. W. K., No. 20409, a primipara, age 22, was brought to the Chicago Lying-in Hospital in labor on December 17, 1921, by her physician, because upon making a vaginal examination at the patient's home, he found a prolapsed hand. On admission, the temperature was 100° and the pulse rate 100. The membranes had ruptured 2 days previously and the fœtal heart tones were regular. Abdominal examination was unsatisfactory, but rectally the prolapsed hand was felt and the cervix was found to be dilated 3 to 4 centimeters. Because the membranes had ruptured, the cervix only partially dilated, a hand prolapsed and pains weak, I decided to insert a colpeurynter into the uterus. On making a vaginal examination previous to the insertion of the bag, the right hand was felt and alongside of it, an acranial head. A ten centimeter bag was inserted and when about half full of lysol solution, there was a sudden gush of bright red blood, approximately 300 cubic centimeters being expelled. The bag was quickly filled and traction made. On examination, a portion of the placenta was found resting between the colpeurynter and the right side of the cervix. We were dealing with a placenta prævia partialis. A one and a half pound weight was attached to the bag and the pains gradually became stronger. The fœtal heart tones remained regular and there was no bleeding. Despite strong contractions, dilatation of the cervix was slow, so morphia and scopolomine were given hypodermically. At 4.30 p.m. December 18, exactly 24 hours after its insertion, the bag was expelled spontaneously. Rectal examination revealed the prolapsed arm and the acranial head. The cervix was dilated 6 centimeters[1] and since there was no bleeding, labor was permitted to progress. At 6.10 p.m., the fœtal heart tones could not be heard, and at 6.30 p.m., the hand was visible at the vulva. The arm was liberated, a vulsellum was placed on the fœtal head, forceps were applied, and the head very easily delivered. The rest of the child followed readily. The placenta was removed manually and found to contain many succenturiate lobes. One portion of the placenta, measuring approximately 7 by 5 by 3 centimeters, was very dark and boggy. This was the portion which had projected from the cervical orifice after the insertion of the bag. The fœtus, in addition to being an anencephalus, had a marked pigeon-breast and a deformed right wrist. The latter, however, on X-ray examination, appeared normal. The patient refused to remain in bed after the third day post-[illegible] perfectly well.

Case 6. (Author's second case.) Mrs. S. McC., No. 24997, age 30, a quintipara, with a negative past history, was admitted to the Chicago Lying-in Hospital on September 29, 1922, because of a severe uterine hæmorrhage. She was in the seventh month of pregnancy. On admission rectal examination revealed a double footling presentation in the presence of a partial placenta prævia. About 600 grams of clotted blood were removed from the vagina and slings were placed on both feet of the fœtus. A weight was attached to the slings and after 4¼ hours the fœtus was expelled spontaneously. There was no bleeding following this and the placenta was expressed from the uterus after it had separated. The portion of placenta which had been felt per rectum and per vaginam, was covered with an old blood clot. The fœtus, which weighed 920 grams, was an anencephalic monster. The patient made an uninterrupted recovery and went home on the tenth day. A Wassermann test made during pregnancy had been negative.

In considering the etiology of monsters, we must, according to Mall (16), distinguish two groups: First, the monsters in which the proper conditions to produce them are already in the germ (and are therefore inherited), and secondly those due to certain external influences which act upon the egg after it is fertilized. Mall believes that defective development is due to "faulty implantation." He says: "All our experience in teratology, if read aright, indicates that the normal ovum, getting into a diseased uterus, did not implant itself well, and the consequent impairment of nutrition produced a monstrous embryo. This hypothesis explains fully the presence of so many pathological embryos in multiple abortions and the apparent germinal origin of merosomatous terata like spina bifida and anencephaly." He also says: "They (ova) could not attach themselves successfully to the diseased uterus and, because of malnutrition or of poisons which are thrown out from the inflamed surfaces, the chorion becomes pathological and the embryo deformed. . . . Abortion usually follows as a result of serious lesions in the chorion as well as in the environment. Should the alterations in the embryo and in the chorion be very slight and the condition of the uterine mucous membrane, which may be expressed by the term inflammatory, be overcome, the pregnancy in all probability would go to term and end in the birth of a monster or an infant presenting a well recognized malformation."

In a large number of the placenta prævia cases a history of some antecedent disturbance in the uterine mucosa may be elicited. In nearly all cases of placenta prævia, there is "obtained a history of abortion, of manual removal of the placenta in previous labors, of recurrent placenta prævia and other evidence of a diseased endometrium, and the findings on the placenta often confirm the endometritis as the predisposing factor." (De Lee, 17.)

Von Winckel (18) collected 87 fœtus from tubal pregnancies which continued to live and were removed alive from the abdominal cavity, and he found that 57 of them were much deformed and 12 were markedly monstrous. The placenta was usually deformed, sometimes multiple, broad and thin or short and thick and often very hæmorrhagic. Mall (19), commenting on this says: "For the 12 cases which were markedly monstrous, we must hold the hæmorrhagic placenta responsible, which could be included under what I have termed faulty implantation."

Stockard (20) agrees with Mall that faulty environment stands in causal relationship to fœtal monsters, but from his experiments he believes the modus operandi to be essentially an inadequate oxygen supply. Stockard says: "In view of experimental results, it becomes evident that the normal development of the vertebrate embryo depends acutely upon the stability of certain factors in the environment. Changes in the conditions of moisture, temperature, and oxygen supply are the most frequent causes of embryonic death as well as monstrous development." The primary cause of all abnormal developments is reduced by Stockard to a single factor, namely developmental inhibition or arrest. The type of deformity that results depends solely upon the exact moment when the interruption occurs. Stockard's experiments were confined mostly to fishes, but according to Arey (21), these concepts "should apply equally well to human abnormalities and twinning provided the ovum is subject to delay before implantation and to arrest afterward. There is ample

evidence for both conditions in the tube." Also, "there is a demonstrable frequency of faulty implantation in tubal pregnancies. Mall failed to find a typical decidua here and its functions in checking hæmorrhage by forming a dam between the tips of the villi and the eroded mucosa is foregone. Numerous hæmorrhages result. Checks, permanent or temporary, while the chorion is struggling to overcome natural deficiencies in its nidus are sufficient to account for . . . the observed double frequency of malformations in these specimens over the uterine group."

In placenta prævia, conditions may be likened somewhat to those in tubal pregnancy. The decidual reaction in the lower uterine segment, while much more efficient than in tubal pregnancy, is not as complete as in corporal pregnancy. The chorionic villi in the lower uterine segment may invade the uterine muscle as do the villi in tubal pregnancy. Nutritional disturbances (Mall) or disturbances in the oxygen supply (Stockard) may, therefore, take place in cases of placenta prævia just as well as in tubal pregnancy and produce monsters, although not so frequently.

An explanation for the occurrence of fœtal monstrosities in cases of placenta prævia may be as follows: For some reason, the ovum is implanted in the lower uterine segment. When this happens, there is a faulty relation between the placenta and the fœtus. In cases of faulty relation between placenta and fœtus there are arrests of development and where arrests are present, monsters occur.

Twelve of the twenty-one monstrosities mentioned in this paper had cranial and intracranial defects. An explanation for this frequency may be found in Mall's statement: "When we consider the whole ovum, it is the embryo itself which is first destroyed, while within the embryo, the central nervous system or the heart is the portion which is first affected" (22). A case of missed abortion which I (23) studied histologically, is in accord with Mall's assertion.

Of what clinical importance is the association of fœtal deformities with placenta prævia? First, dangerous and even fatal bleeding may result from placenta prævia associated with such a deformity as hydrocephalus, when delivery is attempted through the vagina. Hoenck's patient in whom this association was present, died from hæmorrhage while attempts were being made to deliver the head. Secondly, obstetricians are resorting to cæsarean section more and more in the treatment of placenta prævia, especially in a primipara or in a multipara with an undilated cervix.

The abdominal route as a means of delivery in placenta prævia is selected chiefly in the interest of the child. Picture the consternation of the operator when he delivers a fœtal monstrosity, especially if he had urgently advised cæsarean section to the parents who were anxious for a living child. If the association of fœtal monsters with placenta prævia were more common than it is, cæsarean section as a means of treating placenta prævia would lose much of its deserved popularity.

How is one to tell before delivery whether a fœtal monster or deformity is present? Usually it is a very difficult matter. The fœtal heart tones are present in practically every case where cæsarean section is considered, but a correct diagnosis of presentation and position is not easily made. First it is not considered safe to make a vaginal examination in a case of placenta prævia where an abdominal operation is contemplated. Even a rectal examination is not without danger, especially that of starting a hæmorrhage. Because of these facts and because even in the cases where examinations are made, great care is exercised and a very thorough examination is not usually made, it is not often possible to detect any abnormality in the child, even if one is present. It is conceivable that anencephalus or hydrocephalus may be diagnosed, but thus far, there is no case on record known to the author, other than his own (Case 5), in which the diagnosis of anencephaly associated with placenta prævia was made before delivery. It is therefore advised that in cases of placenta prævia where the occiput is not definitely felt or where the head feels unusually large, an X-ray picture be taken. This will usually reveal the deformed skull. It is conceivable that with improved technique, an X-ray plate may perhaps show a deformed spinal column or spina bifida

Other abnormalities, such as eventration of the viscera and defects in the soft tissues are practically unrecognizable under present conditions. However, since more than half of the above-mentioned fœtus had skull deformities, they would most likely have been detected in roentgen-ray pictures. A number of cases of hydrocephaly and anencephaly has come under my observation where the diagnoses were made by X-ray pictures before delivery.

One may go a step farther and take an X-ray picture in all cases of placenta prævia where a cæsarean section is contemplated. It might be added parenthetically, that in all cases where abdominal delivery is planned, regardless of the indication, and where a definite occiput is not felt or where the head appears unusually large, it might be advisable to have an X-ray picture taken before operation, a point emphasized in De Lee's *Obstetrics*.

SUMMARY

An attempt has been made to prove that fœtal monstrosities and deformities not infrequently occur in cases of placenta prævia. To fifteen cases found in the literature, the author has added six more. This by no means represents the total number of cases to be found in the literature, for most of the cases have been hidden in articles the titles of which give no clue to the subject here discussed. Many case records of teratological births will undoubtedly reveal an associated placenta prævia, but the latter is not named in the title of the communication.

It is the belief of the author that the monsters associated with placenta prævia are due to the faulty relation between the placenta and the fœtus which gives rise to arrests in development.

Since fœtal monsters not infrequently are associated with placenta prævia, it is advisable in cases of placenta prævia where cæsarean section is contemplated, to try to ascertain by physical examination and especially by X-ray pictures, whether the fœtus has a deformity.

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Note.—On January 14, 1923, we had another patient at the Chicago Lying-In Hospital who had placenta prævia partialis and who gave birth to an anencephalic monster (Mrs. B. O., No. 26695).

IMMEDIATE VERSUS DELAYED OPERATION IN CASES OF COLLAPSE FOLLOWING RUPTURED ECTOPIC PREGNANCY

By E. M. HAWKS, M.D., New York

IT is agreed that in cases of shock from hæmorrhage due to a ruptured ectopic pregnancy, pain should be relieved, examination avoided, and external heat applied, but it is a question whether operation should be done at once or deferred. Fluids are generally withheld unless operation is planned immediately. An ice bag to the abdomen should not be used, as cold increases the shock.

The point most in dispute is the time of operation, and it is the object of this paper to present clinical evidence afforded by 184 cases, which were in critical condition. One hundred and thirteen of these were operated upon immediately and 71 were treated expectantly.

There would be no question as to the time of operation if all the cases improved under palliative measures, for surely it is preferable to operate when the patient is in comparatively good condition, but unfortunately a fair percentage of these serious cases die when left to themselves or when treated expectantly. This statement has been denied. Robb[1] reported twenty cases of ectopic gestation of whom five were in poor condition and asserted that all patients in collapse would improve under care. Simpson[2] reported one hundred cases of ectopic pregnancy and stated that he had not seen a death from hæmorrhage. Many other writers, however, report one or more deaths from hæmorrhage in their experiences. The author well recalls two non-operative deaths reported by Barber to the Society of the Alumni of the Woman's Hospital and recently was much impressed by a death from hæmorrhage of a private case. Stimulated by that death I have sought evidence as to the frequency of this calamity and have reviewed the histories of several hundred patients in three hospitals that receive many of these serious cases through their public ambulance services. Drs. F. C. Holden of Bellevue Hospital, I. S. Haynes of the Harlem Hospital and E. H. Pool of the Second Surgical Division, New York Hospital, kindly gave me the privilege of studying their case records. Of 824 cases of ectopic pregnancy, 187 were in various degrees of collapse. One hundred and thirteen of these urgent cases were operated upon immediately in these three institutions. Of the remaining 74 cases, 10 died from hæmorrhage, unoperated upon. Three of the ten, through errors in diagnosis, did not receive regular palliative treatment. Omitting them we see that of 71 critical cases treated expectantly, seven (10 per cent) died from hæmorrhage.

In the Medical Examiner's Office, the writer was furnished with complete records of 21 deaths from hæmorrhage in unoperated upon cases of ruptured ectopic pregnancy during the 4 years from 1918 to 1921 inclusive. Eight of these deaths occurred at home and 13 in hospitals.

The files of the Board of Health show that in 1921 in the Borough of Manhattan there were 20 deaths from ectopic gestation and that 5 of the 20 were due to hæmorrhage in ruptured cases—unoperated upon.

A brief account of the deaths in the unoperated upon cases is given in the table.

Death from hæmorrhage, therefore, does occur and with sufficient frequency to warrant the attempt of the immediate operation to forestall it, provided the attendant mortality is favorable.

Let us now look at the results in the two series of cases, i.e., 113 operated upon immediately and 71 with expectant treatment and deferred operation. In the series of 113 cases with immediate operation there were 10 deaths (8.8 per cent). Five deaths were due to postoperative shock, one to peritonitis, one to intestinal obstruction, two to pneumonia and one to cerebral embolism and pneumonia combined. In the second series of 71 cases, with expectant treatment and deferred

[1] Am. J. Obst., lvi, 6.

DEATHS FROM HÆMORRHAGE IN UNOPERATED UPON CASES OF RUPTURED ECTOPIC GESTATION

Case No.	Place	Diagnosis	Time (Rupture to Death)	Autopsy
1	Home	Acute indigestion	9 hours	More than 2 quarts of fluid and clotted blood in peritoneal cavity. Left tube ruptured near cornua. Opening ½ inch long.
2	Hosp.	Ruptured ectopic	4 hours	1500 cubic centimeters of fluid blood and large quantity of blood clots in peritoneal cavity. Site of rupture not stated.
3	Hosp.	Not certain	32 hours; ½ hour after admission.	Peritoneal cavity filled with fluid and clotted blood. Rupture at cornua—opening 1 inch long.
4	Home	Unattended	1 hour	No autopsy—history typical—pregnant 3 months—vaginal bleeding 2 months. Body exsanguinated.
5	Hosp.	Appendicitis	48 hours	Rupture at middle of right tube. Opening ¼ inch long.
6	Hosp.	Not certain	48 hours after rupture. 1½ hours after admission.	More than 2 quarts of fluid and clotted blood in peritoneal cavity. Right tube ruptured at middle, 2 months gestation, sac intact.
7	Hosp.	Surgical abdomen	14 hours after rupture; 12 hours after admission.	Peritoneal cavity filled with fluid and clotted blood. Perforation ½ inch long at right cornua.
8	Home	Gastritis and acute indigestion.	24 hours	Left tube ruptured at middle.
9	Home	Not attended	4 hours	Right tube ruptured near uterus. Opening ⅜ inch long.
10	Hosp.	Ruptured ectopic	2¾ hours after admission.	Rupture of 2 months gestation sac in left tube. Site not stated.
11	Hosp.	Acute general peritonitis	48 hours	Peritoneal cavity filled with blood. Right tube ruptured in outer half.
12	Hosp.	Ruptured ectopic	6 hours after rupture, 3 hours after admission.	No autopsy.
13	Home	Not made	Not stated.	2500 cubic centimeters of blood in peritoneal cavity. Rupture ½ inch long at middle of right tube.
14	Home	Not made	3 hours	No autopsy—typical history. Body exsanguinated.
15	Hosp.	Ruptured ectopic	55 minutes after admission.	Two quarts of blood in peritoneal cavity. Perforation ¼ inch long at middle of tube. Side not stated.
16	Hosp.	Not certain	6 hours after admission.	Large quantity of blood in abdomen. Right tube ruptured in middle third.
17	Home	Not attended. Had been in hospital 3 days and had gone home against advice.	Not known	Peritoneal cavity filled with clotted blood. Rupture 3 inches long across site of an interstitial pregnancy. Fœtus 16 centimeters long, lay in cavity in left horn.
18	Home	Appendicitis	24 hours.	Rupture near outer extremity of left tube.
19	Hosp.	Internal bleeding	1 hour 35 minutes after admission.	Abdomen filled with fluid and clotted blood. Right tube ruptured at middle opening, the size of a goose quill.
20	Hosp.	Shock and collapse	24 hours after rupture, ½ hour after admission.	Abdomen filled with clotted blood. Right tube ruptured and contained two-month embryo. Site of rupture not stated.
21	Hosp.	Not stated	Not stated.	Autopsy showed that death was due to ruptured ectopic pregnancy. No details given.
22	Hosp.	Ruptured ectopic	40 hours after admission.	Rupture at middle of left tube.
23	Hosp.	Collapse	8 hours after admission.	Two litres of blood in abdomen. Rupture at middle of left tube.
24	Hosp.	Ruptured ectopic	12 hours after admission.	Details of autopsy not learned.
25	Hosp.	Ruptured ectopic	2 hours after admission.	Autopsy showed ruptured interstitial pregnancy.
26	Hosp.	Collapse	45 minutes after admission.	Details of autopsy not learned.
27	Hosp.	History of ectopic	20 minutes after rupture in ward.	Details of autopsy not learned.
28	Hosp.	Fibroids and acute pyelitis.	45 minutes after rupture in ward	Details of autopsy not learned.
29	Hosp.	Unruptured ectopic	3 hours after vaginal examination in hospital.	No autopsy.

operation, there were 12 deaths (17 per cent). Four deaths due to postoperative shock, 7 to hæmorrhage unoperated upon and one to cardiac dilatation. Practically, then, the better results were obtained from the immediate operation in the three hospitals considered.

In recent years both methods of treatment have improved and those who advocate either may be loath to accept the results in cases that date back 10 years or more as do some cited above. In the service of Dr. E. H. Pool at the New York Hospital, cases showing signs of hæmorrhage have all been operated upon as soon as possible after admission. It is felt that those apparently in shock may be suffering from hæmorrhage. The two conditions cannot altogether be differentiated. A slow weak pulse suggests syncope. A rapid weak pulse indicates hæmorrhage. Warmth and fluids are indicated for each condition but hæmorrhage should be arrested. Therefore, measures to combat shock,—morphine and heat—are immediately inaugurated on admission and intravenous fluid administered as operation is begun. Thus early operation with arrest of hæmorrhage is enforced and it is rendered safe by the administration of fluids. There have been 21 critical cases in the last 6 years with one death on the fourth day postoperative from cerebral embolism and pneumonia.

Theoretically it seems to the writer that the vital thing needed by these cases in collapse from hæmorrhage is the addition intravenously of warm circulating medium such as saline,

gum glucose solution, or blood. Fluids cannot be given, however, unless operation is planned to follow soon or done coincidently. Infusion and transfusion give the immediate operation a great advantage. They enable one to gain some control of the situation. A small amount of fluid will often revive almost immediately a patient *in extremis* and make an operation possible. With the vessels tied one may give gum glucose solution or blood as needed. Whereas, if an immediate operation is not planned, fluids must not be added to the circulation and the slower method of the patient taking up her own serum must be relied upon. If she is cold and pulseless the chance of her doing this even slowly is not always good. Those cases that die in the wards within an hour or so would seem to have a better chance if they were infused and operated upon immediately and transfused later if necessary.

SUMMARY

1. Deaths from hæmorrhage are not uncommon.

Of 824 cases of ectopic pregnancy, 187 were prostrated from hæmorrhage.

There were 10 deaths from hæmorrhage in 74 of these cases. The remaining 113 were operated upon immediately.

The Medical Examiner's office has recorded 21 deaths from hæmorrhages in the last 4 years.

The records of the Board of Health show that in 1921 there were 20 deaths from ectopic gestation in the Borough of Manhattan and that 5 of the 20 died from hæmorrhage unoperated upon.

2. The immediate operation in the serious cases gives the better result.

Mortality in 113 consecutive cases of collapse operated upon immediately in three institutions was 8.8 per cent.

Mortality in 71 consecutive cases of collapse with expectant treatment and deferred operation in two institutions was 17 per cent.

In a more recent series of 21 consecutive cases of collapse in one institution operated upon immediately, there was one death.

A STUDY OF THE CASES OF CARCINOMA MAMMÆ OPERATED UPON BY MYSELF AND THE END-RESULTS OBTAINED IN THEM

By J. E. SADLIER, M.D., F.A.C.S., Poughkeepsie, New York

IN this paper it is my purpose to bring to your attention a brief study of all the cases of carcinoma of the breast operated upon by me during the past 20 years; that is, from January 1, 1900, to January 1, 1921.

A very determined effort has been made to trace all cases. Fortunately our records were rather definite as to naming some relative and this helped materially in finding out the end-results in the case of those who died. Hence, I am pleased to report that each one of the entire series of 70 cases operated upon during this twenty-year period has been definitely traced and the end-result determined. In this particular the record is somewhat unusual.

In our case histories we have been most anxious to determine the length of time the growth has existed prior to operation and while in a few cases we have definite information, yet in the main the question is most indeterminate, as the patient usually discovers the tumor after it has been in existence for many months. Therefore, what knowledge we have on this subject is of no material value.

All operations in this series have been of the radical type and while we have varied from time to time with reference to plan of skin incision, method of approach to axillæ, the particular type of plastic closure, etc., we have nevertheless always kept steadfastly in mind the necessity for removing all possible cancer-bearing tissue, as was so ably brought to our attention during the last decade of the nineteenth century by Halsted, Meyer, and others, and still later by the splendid studies of Handley. Hence, the pectoral muscles with the exception of the clavicular portion of the major have been sacrificed, the axillæ carefully dissected and, where it was involved or suspected of being involved, the supraclavicular region was also cleared of all glandular and fatty tissue. Vast areas have had to be skin-grafted or plastic operations performed to cover, where by reason of the extensive character of the neoplasm it has seemed best to sacrifice much skin. In fact, no incomplete operations were done. In some cases it was necessary to perform secondary operations for local recurrence or for supraclavicular involvement which had not been suspected at time of primary operation. Thus, we have all cases in this group upon the same basis in so far as completeness of operation is concerned.

During this period of 20 years I can recall no patient who was refused operation; in fact, all patients who presented themselves were operated upon and given a chance, and though I am convinced that in certain cases this was a mistake and a mutilating operation was performed which in no way stemmed the course of the disease, still, in other cases that seemed quite as advanced, we have patients living years afterward and free from malignant disease. Human judgment and laboratory studies of removed specimens seem inadequate to determine definitely what the outcome is going to be in any operated case. I do believe that in the future proper X-ray study of the mediastinum, bones, etc., prior to operation will cause us to eliminate some cases that otherwise we would operate upon, and in my recent work I have adopted this procedure.

All pathological specimens of this series were given careful laboratory study. In most cases frozen section at time of operation was practiced though it was always confirmed later by more deliberate and careful pathological examination. Yet, I find that in a few of our early cases we have failed to record the exact type of malignancy. These we have placed in a separate table.

During the period involved in this series of malignant cases there were also operated upon 31 cases of benign tumor of the breast, including one case of tuberculosis. These were naturally less extensive operations, excisions, simple amputations, subcutaneous amputations, etc. The relative proportion of benign

TABLE I.—TYPE OF CANCER

Total Number of Cases of Cancer of the Breast, 70

	Cases	Percentage
Scirrhus	34	48.5
Medullary	17	24.2
Type unknown	7	10.
Adenocarcinoma	6	8.5
Duct	3	4.2
Sarcoma	2	2.8
Cyst carcinoma	1	1.4

TABLE I, a.—AGE

	Cases	Percentage
21 to 30	1	1.4
31 to 40	8	11.4
41 to 50	18	25.7
51 to 60	24	34.2
61 to 70	11	15.7
71 to 80	7	10.
Over 80	1	1.4

to malignant tumors, 1 to 2¼, is somewhat greater in favor of the benign than is usually considered to be correct. These benign cases have been traced and all are found to be living and no case has developed malignant disease, which speaks forcibly for the early operative treatment of benign tumors in the mammary gland. Whereas, we have among the series of 70 malignant cases, patients who were known to have had simple tumors of the breast for many years which later became malignant and were subjected to radical operation with only the usual modest percentage of ultimate cure. For example:

Mrs. H. M. G., age 53. Marked family history of cancer. Mother of six children. No difficulty with breasts during lactation.

About three years prior to operation patient noticed a small lump in right breast. It was not painful and was examined by a prominent surgeon who pronounced it a benign tumor and counselled against removal although a certain amount of X ray treatment was prescribed without benefit. It was later punctured by the same surgeon under the suspicion that it might be a cyst. During the 3 years that it was being watched and treated from the non-surgical standpoint it gradually increased in size. Finally, when there developed within it sharp stinging pains its removal was sought. It was freely movable and there was no palpable axillary involvement. Under suspicion that there was danger of it ultimately becoming malignant an operation was decided upon. A frozen section made at time of removal proved it to contain a carcinomatous area. A radical operation was performed in March, 1907. Patient is still living, without recurrence.

No effort has been made in this study to separate the cases with glandular involvement from those with no such palpable metastases. We feel that such distinction, without referring to the certainty that goes with mediastinal or remote glands, is of value from the standpoint of prognosis. According to Halsted, cases without glandular involvement have about a 70 per cent chance of cure, whereas those with such involvement have but 25 per cent prospect of ultimate recovery. Recent statistics received from Sistrunk of the Mayo Clinic (personal communication) show that 64 per cent of cases with no glandular involvement are alive without recurrence from 5 to 8 years after operation, whereas only 10 per cent of those with glandular involvement are alive and free from recurrence for the same period. These figures are convincing and leave no argument as to the necessity for early radical operation. It is a settled question that cases with glandular involvement have a decreased chance of cure, but as malignant breasts have an operability of about 100 per cent—at least, it was so determined in this series—we have to take them as they present themselves and do the best we can for them.

Therefore, for the purpose of this study and in order to determine the final end-result in a series taken in the condition in which they present themselves it is best not to attempt such differentiation, especially when we consider that in many cases such determination can be arrived at only after operation and pathological study, and even then it is not absolute unless a vast number of sections have been made. Hence, we are interested in knowing and publishing the end-results from cases taken as they came, regardless of the stage of disease, thereby endeavoring to bring to public notice statistics which will be convincing that operative procedure has a definite life saving value as based upon present condition of public knowledge and methods of surgery.

I am pleased to report that in this series, there was no operative mortality, all patients having left the hospital alive.

I have definitely determined that of the 70 cases of the series which includes two cases of sarcoma, we have alive and free from recurrence 23 cases, representing 32.85 per cent of the total number operated upon (see Tables IV and IV, a).

TABLE II.—DEATHS

Number of Deaths in the Series from Cancer, 36, or 51.4 per cent

	Cases	Per cent of Deaths	Per cent of Type
Scirrhus	16	45 6	47 0
Medullary	11	31 4	64.7
Type unknown	5	13 8	71 4
Adenocarcinoma	1	2 8	10 0
Duct	2	5 0	66.6
Sarcoma	1	2 8	50 0

TABLE II, a.—LENGTH OF TIME AFTER OPERATION PATIENTS DIED

	Cases
One year after operation	20
Two years after operation	8
Three years after operation	4
Four years after operation	1
Six years after operation	1
Seven years after operation	1
Eight years after operation	1

There have died from other conditions *without* recurrence of carcinoma and with an interval of from 1 to 10 years of perfect health conditions 10 patients, representing 14.2 per cent of the whole series (see Table III).

These added to 32.85 per cent living without recurrence a total of 47.05 per cent who are either living without recurrence or dead of other conditions without recurrence.

I appreciate the fact that there are 5 cases operated upon within the past 3 years included in this series of cases without recurrence that are still in the doubtful stage. But as this paper has to do with our result after a 20-year period rather than some particular period after operation I feel that it is correct to incorporate them. Nevertheless, let us consider the series from the standpoint of those living 3 years from time of operation and free from recurrence (see Table IV, b).

Here we find that 26, or 37.1 per cent of the series, are alive, or dead of other conditions, 3 years or more after operation and without recurrence of cancer.

As I study my cases and the tables here shown I am impressed with the well-known thought that cancer varies in grade of malignancy and virulence much as other disease does. As representing this point as to the extremes of malignancy, I would briefly describe the following cases:

Miss E. T., age 32. This case, classified under Table II, a, is distinctive of the type of cancer of extreme malignancy, dying within 1 year following date of operation, and perhaps a type which would be quite as well off with a simple amputation as no operation seems to be of any lasting benefit.

TABLE III.—DYING FROM OTHER CAUSES, WITHOUT RECURRENCE

Number of Years after Operation	Cases	Types
Under 1 year	1	Scirrhus
After 1 year, under 2 years	1	Scirrhus
After 2 years, under 3 years	3	Scirrhus Duct Cyst
After 3 years, under 4 years	2	Scirrhus Type unknown
After 5 years, under 6 years	1	Medullary
After 10 years	2	Scirrhus Adeno
Total, with percentage of the series	10	14.2 per cent

Previous to September 7, 1902, patient had no knowledge whatsoever of the existence of any tumor. Upon said date she discovered a distinct hardness of the right breast and within 3 weeks thereafter entered the hospital for operation.

A diagnosis of extensive cancer of the breast and axillary glands was established. A radical operation was performed with resulting uneventful recovery. Type of cancer: duct carcinoma. Within a few weeks there was extensive involvement in the region operated upon and throughout the shoulder. Patient died within 6 months of both external and internal cancer.

The rapidity and virulence of the growth leads one to suppose that the very act of operation spread the malignant process more rapidly than otherwise would have been the case.

Mrs. J. W., age 65. This case represents the cancer which has been in existence for a long period of time, and one doubts the wisdom of operative procedure, yet later events prove that occasionally such a case is cured, the patient living for many years finally to die of some other trouble.

For 3 years this woman had a painless but gradually enlarging tumor, of hard consistency, developing in the right breast. She had repeatedly been advised to have it operated upon and it was only after it had ulcerated and was extremely foul-smelling, so much so as to make it rather obnoxious to the inmates of the Old Ladies' Home in which she resided, that she finally consented to enter the hospital for operation. At this time the glands in the axilla showed marked involvement and the patient was emaciated to a great extent. At the time of her operation it was considered that a cure could hardly be looked for. Nevertheless, a radical operation was performed. The patient made an uneventful recovery, living 10 years without recurrence and finally passed away as a result of pneumonia.

TABLE IV.—NUMBER LIVING WITHOUT RECURRENCE, 23, OR 32.85 PER CENT OF SERIES

Type	Cases	Per cent of Living	Per cent of Type
Scirrhus	12	52.1	35.2
Medullary	5	21.7	20.4
Adeno	4	17.3	66.0
Sarcoma	1	4.2	50.
Unknown type	1	4.2	14.2

TABLE IV, a.—LIVING WITHOUT RECURRENCE, WITH NUMBER OF YEARS

	Cases
Over 1 year	3
Over 2 years	2
Over 3 years	2
Over 4 years	4
Over 5 years	1
Over 6 years	1
Over 7 years	2
Over 8 years	1
Over 9 years	1
Over 10 years	1
Over 12 years	1
Over 14 years	2
Over 15 years	2
	23
Living with recurrence after 3 years	1

TABLE IV, b.

	Cases	Per cent of Series
Living more than 3 years after operation	18	25.7
Died of other causes, after 3 years, without recurrence	8	11.4
	Cases	Percentage
Total number cured, based on 3 year period	26	37.1

TABLE IV, c.

	Cases	Per cent of series
Living more than 5 years after operation	14	20.
Died of other causes, after 5 years, without recurrence	3	4.2
	Cases	Percentage
Total number cured, based on 5-year period	17	24.28

Thus recognizing that the degree of virulence of the disease is one of the greatest factors in determining the result, may it not be possible for us to make a more intensive study of each case prior to operation and thereby anticipate some of our unfortunate results? For instance, given a case in a relatively young person with rapid development of growth and early involvement of glands, would it not be wise to assure ourselves prior to operation that there is no mediastinal or bone involvement and inquire most carefully as to there being any cough, dyspnœa or evidence of involvement of the chest, carefully examine the liver and investigate the patient from all standpoints? The fact that 20 or 28.5 per cent of this series died within 1 year from the time of operation inclines one to consider that among the number there must have been some who were hopeless when operated upon and should not have been subjected to it or at least should not have had the radical mutilating operation.

In contradistinction to the above are the cases occurring in older people where the disease has been in existence for from 1 to 3 or 4 years and in some there is supraclavicular as well as axillary glandular involvement but no evidence of intrathoric or distant metastases. Here we have in spite of the long existence of the growth a fair prospect of ultimate success. My experience coincides with that of Pilcher, with respect to the possible curability by operation of cases where there is supraclavicular involvement and it is high time that we throw into the discard the old idea that such involvement renders a patient hopeless. Case 14 of this series, operated upon March, 1906, had extensive supraclavicular involvement and is now in perfect health, 15 years from date of operation. Another, with extensive involvement above the clavicle, lived for 6 years and died of other conditions, and a third lived for 10 years without recurrence of cancer.

In Table II, a, we notice that 32 of the 36 deaths from cancer occurred within the 3-year period. This adds strength to the argument that patients are relatively safe who have passed the 3 years after operation without recurrence and especially is this so when we analyze some of the so-called late recurrences, for frequently we are apt to find that we are not dealing with a metastasis but rather with a definitely new development, as evidenced by the different type of cell.

The following history is instructive from this standpoint.

Mrs. J. T., age 60, operated upon in June, 1904, for a carcinoma of the left breast, which had been in existence so far as the patient knew for only 1 month.

A complete radical operation was performed which necessitated extensive skin grafting. An examination of the specimen showed it to be medullary carcinoma. The patient made a good recovery. However, a few months later it was necessary to do

an extensive operation to remove carcinomatous glands which had developed in the supraclavicular region. From this she also made a nice recovery and remained perfectly well and free from cancer for 6 years. Then she developed suspicious symptoms in the bladder, and a cystoscopic examination disclosed the fact that there was a malignant area. So, in June, 1910, 6 years after her breast operation, a transperitoneal section of her bladder was performed and the diseased area removed. Examination of specimen proved it to be carcinoma which had developed upon a pre-existing papilloma.

She recovered nicely from the operation and remained free from any recurrence in the bladder but later developed carcinoma of the liver and died.

Here we have a case where there is an interval of 6 years between the removal of the breast and the onset of the bladder growth. The cell type was different in each case. Hence, the growth in the bladder can hardly be considered metastatic from the carcinoma of the breast.

Table I, relating to type of cancer, shows about the customary proportion of medullary to scirrhus, 24.2 per cent of former and 48.5 per cent of the latter, but the number of adenocarcinomata is quite below the average, being only 8.5 per cent. The only noteworthy thing with reference to the age of the patients in this series is that 9, or 12.8 per cent, were under 40 years of age. Eight of them are dead of recurrence of cancer and the ninth one died some 10 years after her operation of other conditions but without recurrence. Hence, if we classify this one case as cured we have about 11 per cent of recovery for this group.

Of those living without recurrence, the adenocarcinoma shows 66 per cent of ultimate recovery which represents a high percentage of cure and corresponds with the usual well known favorable outcome in this type of cancer.

Scirrhus cancer has to its credit 35.2 per cent without recurrence and as might be expected the medullary type is least favorable with only 29.4 per cent remaining alive and free from recurrence.

These figures are so nearly in accord with those of other investigators that one is impressed with the definite exactness with which the percentage of cured cases can be determined from the type of cancer.

Furthermore, one recognizes that these figures demonstrate that in a given series, a certain proportion can be cured by radical surgical operation and this percentage of cure is probably as great as operative procedure will obtain, although moderate advantage and increased curability may result from the more general use of X-ray and radium as adjuncts to operation. Yet, the great loss of life that appertains in this disease, in spite of the most perfected treatment, will be lessened only when, through education, the people have learned to know the great advantage of early surgical treatment of the radical type and present themselves without delay. At the present time many patients are so far advanced that the prognosis is grave. Those representing the degree of extreme virulence and those in earlier life will have a very modest percentage of cure, even when, through general education, the public is impressed by the necessity of early radical operation.

OVARIAN PREGNANCY

By F. L. GOOD, M.D., and T. K. RICHARDS, M.D., Boston

CASES of ovarian pregnancy are comparatively rare. This is particularly true of examples of pregnancy which have gone to full term. On this account it seems worth while to put the following case on record.

June 22, 1918. (No. 373868.) The patient, a married Italian woman 32 years old, entered The Boston City Hospital complaining of pain in the lower abdomen and loins. The temperature, pulse and blood pressure were normal. The urine showed the slightest possible trace of albumin. Owing to the patient's inability to speak English, no family or past history could be obtained, except that she had had one previous full-term pregnancy.

Present illness. Beginning 13 months ago the patient had amenorrhœa which persisted for 8 months. For the last 5 months menstrual periods had been regular. She complains of more or less constant pain in lower abdomen and loins.

Fig. 1. Full term ovarian pregnancy within the fœtal sac.

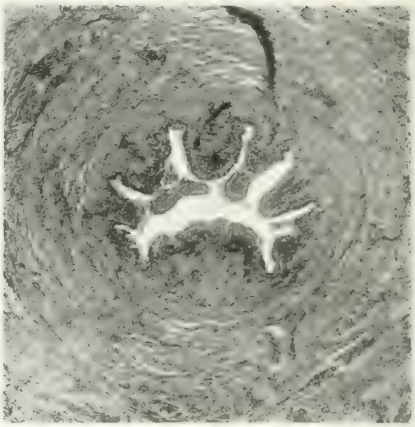

Fig. 2. Section through wall of fœtal sac showing cross section of intact fallopian tube.

Physical examination was essentially negative except for the abdomen which showed a tumor in the lower mid-portion consistent with a 6 or 7 months pregnant uterus. The cervix was not taken up and the os admitted one finger.

June 25. Temperature 102°; pulse, 120: Her general condition remained the same.

June 29. The patient was running an irregular temperature, 100–102°. Pus was found in the urine.

July 1. An *ether examination* was advised since the patient had had no labor pains and as there was some possibility of there being a dead fœtus. The uterus was found to be normal in size and anterior to a large tumor the size of a full-term pregnancy. The diagnosis of ovarian cyst was made, and the possibility of an abdominal pregnancy was considered. Since the patient had given permission to operate it was decided to explore.

Operation. A low, median line incision revealed the intestines and the omentum adherent to a large tumor of the left ovary. The uterus was of normal size and anterior. The right tube and ovary were normal. The adhesions between the intestines and the omentum were separated with some difficulty—both surfaces of the adhesions bled considerably. When the tumor was more fully explored it was found to be adherent at the lower end to the broad ligament and to the bladder (that is, the pedicle of the tumor was attached to the broad ligament). The tumor seemed like a large ovarian cyst, with a thicker pedicle than normal. The wall of the cyst was much thicker and more vascular than is the usual cyst wall. After all the adhesions were broken up it was impossible to find the fallopian tube. It had probably been separated from the broad ligament in freeing the adhesions. The pedicle was tied off and the tumor was removed. On opening the sac of the tumor, a full-term fœtus surrounded by foul-smelling puriform amniotic fluid was exposed. It was impossible to find any ovarian tissue on the left side. The pedicle and the remnants of the broad ligament were sewed over with catgut. A drain was placed at the site of the tumor and the abdomen was closed in layers.

The patient made an uneventful convalescence and was discharged well, 16 days after the operation, 24 days after admission.

Examination at the time of discharge showed the uterus to be in the anterior position and of normal size. The right vault was free. The left vault was slightly indurated. Her general condition was excellent.

Pathological examination showed that this was a true ovarian pregnancy at full term. The specimen was a slightly oval mass 21 by 15 by 11 centimeters, weighing 2520 grams (5½ pounds). The surface was grayish white with many adherent tabs. On one side were the remains of a twisted pedicle by which the mass had been attached to the broad ligament. The mass was distinctly fluctuating. An incision 10 centimeters long disclosed the head and shoulders of a well developed fœtus (Fig. 1). The legs, hands, finger nails etc., were perfectly formed, and there was no evidence of gill clefts or other embryonic structures indicative of anything but a full-term fœtus.

The placenta was attached to the inner wall of the mass, at the end opposite the head. The fœtus was somewhat macerated, the hair and epidermis had desquamated from the head and the shoulders. The body lay in thick yellow, puriform material.

In gross the wall of the mass appeared to be made up of tough fibrous material varying in thickness from 0.5 to 1.3 centimeters. The thicker portions lay over the region occupied by the placenta.

Vertical sections were taken through the wall of the sac at eighteen different places. On microscopic examination all of these sections showed dense fibrous tissue. In addition to this, sections from fifteen of these places showed the remains of corpora lutea—mainly corpora hæmorrhagica and corpora fibrosa. Several of these sections showed the remains of distended ovarian follicles. Others showed follicles with ova still in position (Fig. 3). One series of sections through the wall near the placenta showed not only follicles with ova, and corpora fibrosa, but also a cross section of the oviduct (Fig. 2). The tube was intact but greatly diminished in size owing to extension. Its lumen was about as big as an ordinary pin point—barely visible to the naked eye. Further sections cut along the probable course of the tube showed it to be present and intact. The fimbriated end was spread out over the external surface of the mass. Sections cut from the fimbriated end of the tube showed concentric layers of dense fibrous tissue about 2.5 centimeters thick through which were scattered smooth muscle fibers. Apparently the fimbrated end of the tube had become adherent to the surface of the ovary at some previous time so that when the ovum became impregnated, probably within a follicle, and the ovary enlarged, the tube became stretched across the surface of the organ and was caught in the fibrous tissue eventually formed, giving it the elongated appearance described above.

The microscopic evidence that this is a true ovarian pregnancy at full term is—

1. The presence of ovarian tissue (corpora fibrosa, follicles and ova) throughout the wall of the sac.

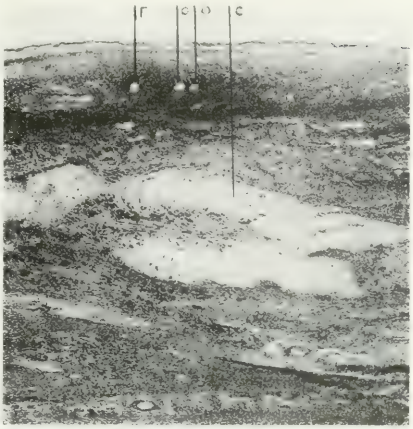

Fig. 3. Cross section of the wall of the fœtal sac showing these ovarian follicles, two containing ova, and corpora fibrosa. *f*, Ovarian follicle; *o*, follicle with ovum; *c*, corpora fibrosa.

2. The presence of the intact tube lying on the external surface of the sac.
3. The presence of the smooth muscle in the external portion of wall of sac, only in the region of the fimbriated end of the tube.
4. The absence of any embryonic structure in the fœtus.

The clinical evidence that this is a true ovarian pregnancy is that—

1. The fœtal sac occupied the normal position of the ovary.
2. No other ovary was found on the affected side.
3. The fœtal sac was connected to the uterus by the ovarian ligament.

THE TREATMENT OF HYDATIFORM MOLE AND CHORIO-EPITHELIOMA WITH A CONSIDERATION OF THE RELATIVE FREQUENCY OF EACH[1]

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VESICULAR degeneration of the chorion, or hydatiform mole, is a condition marked by characteristic microscopical and gross changes in the chorionic villi. Microscopically, we note in the individual chorionic villus, proliferation of the trophoblast elements and myxomatous changes in the stroma and an increase in the syncytium. Grossly, we have presented the characteristic grape-like mass of vesicles.

There is, at the present time, a great difference of opinion as to the frequency of hydatiform mole. Boinvin found that it occurred once in about 20,000 pregnancies; Gebhardt observed 12 cases in 16,000 pregnancies; Hirst states 1 in 3 to 4,000 pregnancies; Williamson 1 case in 2,400 pregnancies. A study of the gynecological records at Bellevue Hospital shows 21 cases during the past 11 years. We have admitted at Bellevue Hospital about 400 abortions a year, hence, out of approximately 4,500 abortions we have discovered 21 hydatiform moles, or 0.4 per cent. I say we have discovered 21 cases for I feel sure that many early cases have been overlooked. When one considers that this vesicular degeneration may be confined to only a small portion of the placenta and that careful examination is necessary to determine the presence of a few vesicles, the possibility of overlooking many cases is apparent. To determine properly the frequency of hydatiform mole one should study the aborted products of conception or placenta under water after careful washing. This causes the distended vesicles to rise to the surface and many cases of limited degree may thus be discovered. As to the frequency of occurrence of hydatiform mole, I am in accord with Meyer who states: "Indeed, how many cases of hydatiform degeneration one can find in abortuses will depend much upon the care with which the examination is made, for the condition undoubtedly is extremely common and not rare as heretofore supposed." It is of vital importance that the profession should appreciate the comparative frequency of hydatiform mole, for by this understanding only can we outline a proper treatment of the condition and only by an understanding of its frequency can we appreciate its relation to chorio-epithelioma, one of the most malignant neoplastic growths.

The mortality from hydatiform mole is at present variously estimated at from 10 to 25 per cent: Dorland stating 10 per cent; DeLee 16 per cent; Hirst 18 to 25 per cent; our series at Bellevue Hospital 9 per cent. The causes of death are given as hæmorrhage, sepsis, and the development of chorio-epithelioma. Both of the deaths in our series resulted from a low grade sepsis superimposed upon an anæmic state caused by a moderate but prolonged bleeding. Perforation of the uterus by the growing hydatid may result in internal hæmorrhage or in peritonitis. This is, however, an extremely rare complication.

Let us now consider chorio-epithelioma. This intensely interesting and but little understood tumor is characterized by a malignant proliferation of the chorionic epithelium. It is a true invasive tumor as its origin is always from the fœtal chorion, excepting the atypical or teratomatous type arising in the testicle. "Microscopically, this tumor is found to be made up almost entirely of broad, irregular, and ragged anastomosing strands of the two types of chorionic epithelium; Langerhans cells, which can be readily distinguished by their smaller and more regular form, with pale or almost clear protoplasm and fairly sharp cell outline, while syncytial material spreads over them or forms solid areas of protoplasm which stains much more deeply and in which numerous nuclei often of great size are imbedded." The confusion

[1] Read before the New York Academy of Medicine, Section of Obstetrics and Gynecology, February 4, 1915.

Fig. 1. Gross picture of fully developed hydatiform mole showing the characteristic vesicles.

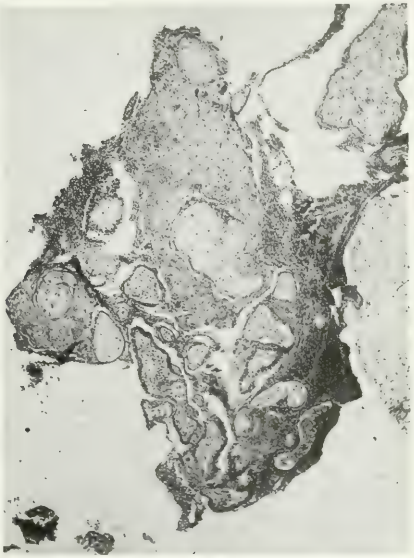

Fig. 2. Photomicrograph, low magnification, showing normal chorionic villi. Taken from a young embryo.

in the consideration of this tumor arises from two causes: first, its difficulty of diagnosis histologically, and, second, the variation in its malignancy. The difficulty in histological diagnosis is caused by its close resemblance to normal chorionic tissue, hence, portions of normal but long retained placental tissue may be misleading. As to the variations in its malignancy it is now generally accepted that the relative malignancy of this tumor can not be distinguished by the histological picture alone. This fact has been emphasized by Hitschmann and Cristofoletti, Aschoff, Pick and Schlagenhaufer, Geist, Fairbairn, and others. Ewing, however, has classified chorio-epithelioma in three distinct types dependent upon the histological picture. Chorio-adenoma-destruens, chorio-carcinoma, and syncytioma, he asserts that the prognosis can be given dependent upon the cell type and arrangement. This opinion, however, is not generally accepted, as I have stated.

It is apparent when one realizes the relative frequency of hydatiform mole that the percentage of occurrence of chorio-epithelioma following hydatiform mole must be low, much lower than is usually supposed. The rarity of death from chorio-epithelioma needs no emphasis. Dr. Douglas Symmers, director of the Bellevue Laboratories, states that during the past 11 years there have been approximately 8,000 autopsies at Bellevue Hospital and more than 35,000 surgical specimens have been examined revealing but one chorio-epithelioma. This, a metastatic chorio-epithelioma of the vulva, was designated as doubtful. If we accept, as we must, the statement of Meyer as to the frequency of early hydatiform mole, it reduces the percentage of chorio-epitheliomata following hydatiform mole to a minimum, probably to less than 1 per cent. The reason for the

great difference of opinion is, first, that many early hydatiform moles are not discovered, thus increasing greatly the actual number of moles, and, secondly many cases diagnosed as chorio-epithelioma are not so in fact.

That hydatiform mole is a precursor of chorio-epithelioma in a large percentage of the actual cases of chorio-epithelioma is an established fact. Pollosson and Violet state that 455 cases of chorio-epithelioma collected from the literature, showed a previous history of hydatiform mole in 366 instances. This is natural to suppose for it is but a slight transition from the syncytial hyperplasia of the vesicular mole to the actual malignant chorio-epithelioma. This, however, by no means permits of the conclusion that a large percentage of hydatiform moles is followed by chorio-epithelioma. Payne believes that about 50 per cent of hydatiform moles are followed by chorio-epithelioma. Findley states that in a series of 250 cases collected from the literature 16 per cent developed chorio-epithelioma, Hitschmann and Cristofoletti from a series of 200 moles show 7 per cent followed by chorio-epithelioma, Vineberg estimates that less than 5 per cent of hydatiform moles are followed by chorio-epithelioma. Gebhardt's series of 12 hydatiform moles followed for 4 years did not show a single chorio-epithelioma, DeLee reports 16 cases, none of which developed chorio-epithelioma. We have had but one chorio-epithelioma at Bellevue Hospital during the past 11 years and that a doubtful case.

I have spent this time in considering both hydatiform mole and chorio-epithelioma for an appreciation of the relative frequency of the former and a realization of the actual rarity of the latter is necessary before it is possible to arrive at a rational conclusion as to the treatment of hydatiform mole. The mole should be treated mainly from the standpoint of preventing hæmorrhage and sepsis; bearing in mind always the *remote* possibility of the development of chorio-epithelioma. This precludes such radical treatment as hysterectomy in all hydatiform moles, primarily for the fear of developing chorio-epithelioma, as has been proposed. We would thus be needlessly sacrificing many uteri and subjecting many cases to an unnecessary and dangerous operation. Curettage should always be avoided, for it is impossible to remove the larger part of the vesicles in this way and it is attended with great danger because of the possible thinning of the uterine wall by the growth. Hitschmann and Cristofoletti state that distant metastasis, as to the lung, is largely caused by surgical interference. As DeLee states, curettes and placental forceps should never be used, in the treatment of hydatiform mole. Vineberg has advised anterior vaginal hysterotomy with manual removal of the mole in all hydatiform moles occurring in women under 40 years of age and hysterectomy in those cases over 40 because of the possibility of chorio-epithelioma. Should the condition of the cervix permit manual uterine exploration, hysterotomy is, of course, unnecessary. This method has none of the dangers of instrumental evacuation of the uterus and it permits palpation of the interior of the uterus. This is a very important matter, for as Eden states and many others agree, a beginning chorio-epithelioma may be noted at the time of evacuation of the mole. The characteristic notation made with beginning chorio-epithelioma is a soft and friable spot in the myometrium from which almost necrotic tissue can be easily removed. Should such a spot be found, which notation will seldom be made, hysterectomy is advisable. By far the larger percentage of cases will be successfully terminated by the manual removal of the hydatiform mole. Such cases should, however, be observed carefully, as is generally agreed, for subsequent irregular uterine hæmorrhage. In the event of such a hæmorrhage, Vineberg advises immediate abdominal hysterectomy. May we not take issue with this form of treatment at this point? A diagnostic curettage in a questionable case of chorio-epithelioma, as is frequently suggested, is worthless, for the microscopical picture alone will reveal nothing or at best a doubtful report. It seems to me that in the event of irregular bleeding following hydatiform mole, a laparotomy with hysterotomy is the most advantageous procedure. By this method we should discover the occasional

Fig. 3. Photomicrograph, low magnification showing beginning hydatiform mole. Note the enlargement of many of the villi with myomatous change in the stroma. A mole of this type is noted only upon careful examination.

Fig. 4. Photomicrograph, low magnification, showing fully developed hydatiform mole with marked enlargement of the villi.

chorio-epithelioma which grows only toward the peritoneal surface of the uterus giving no appreciable change in the endometrium. Such cases are reported by Meyer and Nagy. An abdominal hysterotomy permits a thorough inspection of the uterus as well as palpation and in this way portions of placental tissue retained for a considerable time may be removed and thus many uteri saved. Should the laparotomy reveal evidence of chorio-epithelioma, of course the hysterotomy is uncalled for. The evidence of a chorio-epithelioma may be found in extensive thrombosis of the pelvic veins, or in the appearance of the uterine body.

The use of radium or deep X-ray therapy should be a great advantage in these cases. Probably because of the difficulty in obtaining a series of cases of either hydatiform mole or chorio-epithelioma, I can find no references in the literature as to the efficacy of this form of treatment. The malignant chorionic villus, and this term applies to the hydatiform mole as well as to chorio-epithelioma, should succumb readily to radiotherapy.

A consideration of this subject would not be complete without reference to a frequent accompaniment of both hydatiform mole and chorio-epithelioma; namely, bilateral ovarian cystomata. Coventry states that these cysts are found in 91 per cent of chorio-epitheliomata and in over 80 per cent of hydatiform mole. The histogenesis of these cysts is a matter of discussion; Seitz states that they arise from atresic follicles. Jaffe and Orthman state that they arise by distention and overgrowth of corpora lutea of various ages. The important point to be borne in mind as to this complication especially when it arises in connection with hydatiform mole is that the ovarian cysts are, as a rule, short-lived growths which show no sign of

malignancy and undergo spontaneous regression after the removal of the uterine condition.

CONCLUSIONS

1. Hydatiform degeneration of the chorion is not an infrequent condition.

2. Actual chorio-epithelioma is an extremely rare condition.

3. The relative malignancy of chorio-epithelioma can not be distinguished by the histological picture alone.

4. Hydatiform mole should be treated from the standpoint of hæmorrhage and sepsis, bearing in mind *only the remote* possibility of the development of chorio-epithelioma.

5. Manual removal of the hydatiform mole is the method of choice. If the condition of the cervix does not permit this, vaginal hysterotomy should be performed that manual removal may be possible.

6. Should chorio-epithelioma be suggested by the findings, at the time of removal of the mole, hysterectomy should follow.

7. Curettage is a dangerous and practically worthless procedure as a means of diagnosing chorio-epithelioma.

8. Abdominal hysterotomy, in late cases, suspected of chorio-epithelioma, is the procedure of preference as it permits visual examination of the pelvis as well as the uterine body and endometrium. By late cases I refer to cases with a previous history of pregnancy or hydatiform mole.

9. Radio-active therapy should be efficacious both as a prophylactic and therapeutic measure in chorio-epithelioma.

10. Bilateral ovarian cystomata accompany both hydatiform mole and chorio-epithelioma in over 80 per cent of the cases.

11. Bilateral ovarian cystomata in both of these conditions are short-lived, show no signs of malignancy, and undergo spontaneous regression after the removal of the uterine condition.

The author is indebted to Dr. Emil Schwarz of the Peck Memorial Hospital, Brooklyn, New York, for the use of his microscopical slides in the preparation of this article.

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FIBROMATA OF THE OVARY[1]

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IN the Mayo Clinic from January 1, 1910, to August 1, 1921, fifty-five fibromata of the ovary, not associated with other pathological conditions, were removed at operation. Diagnosis was confirmed by microscopic examination in all the cases in the series. During this same period a total of 4175 tumors of the ovary were removed. One hundred forty-nine (3.5 per cent) of these were fibromata, but 94 were associated with cysts, either benign or malignant, or fibromata of the uterus, and so forth, for which the operation was performed. The incidence of fibromata of the ovary is usually given in the literature as 2 per cent.

CASES REPORTED FROM THE LITERATURE

Fibromata of the ovary were first mentioned by Astruc in 1740, and were later discussed by Baillie, in 1799, and Kiwisch, in 1845. Olshausen, in 1873, found six fibromata of the ovary in a series of 293 cases of tumor of the ovary. In 1874 Leopold collected 59 cases from the literature, in some of which the diagnosis was questionable; in 1882, Coe reviewed 20 additional cases and in 1884, Wells found 3 such tumors in 1200 ovariotomies. In 1902, Peterson reported 82 cases from the literature with 2 of his own. Orthmann, in 1904, reported 10 in a series of 527. In 1905, Basso reviewed 4 cases from Leopold's laboratory, and in 1913, Danforth reported a case in which the tumor complicated pregnancy. In 1914, Fullerton reported one case and Hellman, in 1915, reported 6 cases collected from a series of 4,500 pathological specimens. Clark and Gabe, in 1921, published a paper in which such tumors were discussed. The relative frequency of fibromata of the ovaries and uterus is shown by Hartz who notes that Kelly and Cullen found only three fibromata of the ovary in a series of 934 cases of myomata of the uterus.

The primary origin of fibromata of the ovary has not been determined definitely, although these tumors have been referred to as similar to keloids. They do not have a tendency to recur, however, after removal as is characteristic of keloids. It is quite possible that they may arise from the stroma of the ovary, the corpus luteum, the corpus fibrosis, organized blood clots, the capsule of the organ, or the walls of the blood vessels. Klob, Peaslee, and Olshausen believe that their origin may be traced to inflammatory processes. Hæmorrhage and hyperæmia from mechanical causes are important factors. Infection plays a questionable part, but scirrhotic and retrogressive changes in the ovary at the menopause may be causes.

The tumors may occur at any age after puberty, but more often develop immediately before or just after the menopause. In the series of 55 cases, the greater number occurred during the fourth, fifth, and sixth decades. The youngest patient was 18 years and the oldest was 73. Two patients were between 10 and 19 years, 5 were between 20 and 29, 15 were between 30 and 39, 9 were between 40 and 49, 15 were between 50 and 59, 17 were between 60 and 69, and 2 were more than 70. Twenty-six of the patients were menstruating, 3 were at the menopause, and 26 were past the menopause. Five patients were from 1 to 5 years past the menopause, 10 were from 6 to 10 years past, 4 were from 11 to 15 years past, 4 were from 16 to 20 years past, 2 were 21 and 25 years past respectively, and 1 was 30 years past and had had symptoms during that period.

A study of the series of 55 cases shows that menstruation is seldom influenced by the tumors. This is in agreement with Doran's conclusions from his study of 11 cases. In 24 the menses were regular and practically normal. Five had irregular menses but 3 of these were at the menopause. In only 4 was the flow increased. One had increased flow for 2 years and 1 for 2 months. The youngest patient, 18 years, had not menstruated because of the congenital absence of the uterus and vagina. The average age of the 26 patients

[1] Extract from thesis presented to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Surgery, 1922.

past the menopause was 50.9 years. This is in accordance with Peterson's findings that fibromata of the ovary delay the menopause.

In Peterson's series 44 patients were married and 22 were single. Of the 45 in whom fecundity was mentioned, 33 (73.33 per cent) were sterile. In the 55 from the Mayo Clinic 41 were married, 4 were widowed, 1 was divorced, and 9 were single. Thirty of the 46 had children, 10 had one child each, 4 had two children each, 3 had three, 3 had four, 3 had five, 5 had six, 1 had seven, and 1 had ten. Thus, incidence of fibroma of the ovary was several times greater in married than in unmarried women. The number of children bears no relationship to the occurrence of the tumor.

Fibromata of the ovary may vary from 0.5 centimeter to more than 30 centimeters in diameter. The largest growth in the series measured 35 by 23 by 15 centimeters, and weighed 6023 grams. In one case in which the tumor was bilateral the growth in the right ovary was 17 by 15 by 9 centimeters, and that in the left ovary 18 by 17 by 11 centimeters. As a rule the tumor corresponds to the shape of the normal ovary, but its surface is nodular and irregular. Firmness depends on fibrous consistency or calcareous degeneration; the growths are softer with myxomatous degeneration. They are usually gray or grayish white. The cut surface is glistening white or yellowish white, owing to hyaline degeneration. If the blood supply is unusually rich they appear red or, in the presence of recent hæmorrhage, they may be black.

Microscopically a certain regular arrangement of the individual fibrous cells which frequently form bands or strands is found. If muscle cells are present, they may be derived either from the normal muscle cells of the hilus or the walls of the blood vessels. As a rule the muscle cells are few in comparison with the connective-tissue cells which are short and spindle-shaped, with a slightly bent or pointed nucleus. In large tumors there are practically no muscle cells, because of the interference with the blood supply by the contraction of the fibrous tissue. Practically all forms of degeneration may be seen microscopically; fatty, myxomatous, hyaline, hydropic, and calcareous are the most common. Large tumors contain extensive areas of necrosis. Fibromata may be distinguished pathologically from sarcomata by their less cellular structure and more regular arrangement of cells, and the absence of mitotic figures and embryonal types of cells.

The symptoms are subjective and objective. Among the subjective symptoms, which are comparatively few, is pain in the abdomen, usually dragging, unless the pedicle becomes twisted, when it is very acute and may cause collapse. The pain often radiates to the groin, when it simulates that of renal or ureteral stone. Occasionally pressure causes it to radiate along the distribution of the nerve trunks. Frequent and painful urination, constipation, and pain on defæcation are sometimes complained of. Aching in the lumbar or sacral region is often noted. The patient may not be aware of the tumor, even though it is large.

Objectively the tumor may be fixed by adhesions, but as a rule it is movable. The uterus, in some cases, moves separately from the tumor. Ascites is stated to be present in about 5 per cent of cases and may be due to irritation of the peritoneum. Olshausen believed it the result of mechanical irritation, Schauta attributed it to hyperæmia, and Pfannenstiel and Schatzchen to a secretion of the degenerating tumor. The tumor may be present for several years before it becomes large or gives rise to marked symptoms. However, there are a small number of cases in which the growth is more rapid and the tumor causes symptoms within comparatively few months.

In the 55 cases the tumor was known to be present from a few months to many years; in one case 30 years with comparatively few symptoms. Fifty-two of the 55 patients had symptoms. Seven had had symptoms from 1 to 6 months, five from 7 months to 1 year, sixteen from 1 to 2 years, six from 2 to 4 years, six from 6 to 10 years, one for 12 years, one for 14 years, one for 19 years, and one for 30 years. The duration was not stated in eight.

Pain, the most common symptom, was present in 33 cases, not mentioned in 17, and absent in 5. As a rule, it was not present in

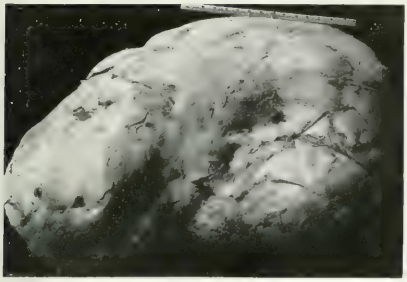

Fig. 1. Surface view of fibroma 35 by 23 by 15 centimeters. Weight 13.25 pounds. (Case A205277.)

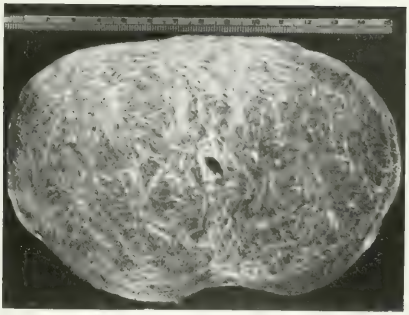

Fig. 2. Fibroma 15 by 11 by 10 centimeters. Striations on cut surface with small cyst in the center of the tumor. (Case A115013.)

the cases of the smallest or very largest tumors. The pedicle was twisted in two cases and caused severe pain and shock. Radiation of pain to the bladder and groin confused the clinical picture, but the paucity of urinary symptoms and negative urinalysis and roentgenograms aided in the differential diagnosis.

Pressure on the bladder and rectum caused symptoms in 26 cases. Frequency of urination was present in 14 of these. Desire to defæcate frequently was present in 2.

The tumor was definitely fixed in 4 cases and movable in 51. It was located in the midline of the lower abdomen and pelvis in 36 cases, in the right side of the pelvis in 12, in the left side of the pelvis in 5, and in the cul-de-sac in 2. Ascites was present in 14 cases (25 per cent). The amount varied from 0.5 to 16 liters. Two patients had also bilateral hydrothorax which disappeared after operation. When ascites is present the clinical picture may be confused with that of malignancy of the ovary, especially when loss of weight and strength are marked. However, the association of ovarian tumors and ascites should be remembered and exploratory operation offered to patients with tumors of the pelvis and ascites unless metastasis is demonstrable.

One ovary only was affected in 53 cases. Both ovaries were affected in the other two. The growths reported in the literature are practically always unilateral.

Twenty-four patients complained of tumor; 12 of abdominal pain; 6 of pelvic pain and distress; 2 each of frequency of urination, falling of the womb and metrorrhagia, and one of menorrhagia.

The diagnosis depends on the presence of a unilateral tumor of the pelvis, non-fluctuating and separate from the uterus. Often no definite diagnosis other than tumor of the pelvis can be made before operation. In the differential diagnosis must be considered pedunculated fibrous tumors of the uterus, solid carcinomata and sarcomata of the ovary, fibrous tumors of the tube, fibrous tumors or adenomyomata. It should be remembered that sarcoma is more common in young persons. Solid carcinomata cannot be absolutely differentiated unless metastasis is present. If ascites is present cirrhosis of the liver, abdominal malignancy, tuberculosis, and so forth should be ruled out.

TREATMENT

The treatment should be surgical, as medical treatment is of no avail. Radium and roentgen-ray therapy should be reserved for cases in which operation is contra-indicated on account of co-existent conditions, such as serious cardiac lesions and nephritis. Operation should be advised for the removal of all ovarian tumors as soon as the diagnosis is made, since malignant degeneration may occur, if it is not already present, or twisted pedicle with gangrene and peritonitis may develop.

The type of operation in the 55 cases varied according to indications found at operation. One ovary alone was removed in 12 cases, one ovary with its tube was removed in 21 cases. Both ovaries and tubes were removed in 6 cases. Subtotal hysterectomy with removal of one ovary and tube was performed in 6 cases, and subtotal hysterectomy with removal of both ovaries and tubes was performed in 7 cases. When both ovaries were removed from patients who had not reached the menopause, one ovary or a part of one ovary was transplanted. Total hysterectomy with removal of both tubes and ovaries was performed in three cases. The uterus was removed in these cases for various reasons, such as prolapse, multiple small fibroids, fibrosis, and chronic endometritis. The appendix was removed in 37 patients; cholecystectomy and gastro-enterostomy for duodenal ulcer were performed in one case. In one case the tumor was found to be parasitic to the omentum and small intestine.

PROGNOSIS

The prognosis is good, especially when solid carcinoma and sarcoma have been ruled out by microscopic examination of the tumor. Pre-operatively and when the patient refuses operation, the prognosis is influenced by the possibility of twisted pedicle with resulting infection, gangrene, and peritonitis, malignant degeneration, and so forth.

In order to ascertain the results following operation, questionnaires were sent to the patients. Particular stress was placed on the effects on menstruation and on the occurrence of pregnancy. Twenty-six patients answered the questionnaires. Of these 10 had not reached the age of menopause and were anatomically able to menstruate. Nine of the 10 menstruated regularly. One ceased menstruating after operation. In 8 the flow was normal in amount; in 1 it was increased. Only 1 complained of dysmenorrhœa. Of the 26 who answered questionnaires, 6 were married, still menstruating, and physiologically and anatomically capable of bearing children. Of these 6 patients, 3 had children after operation; 1 had two children and the other 2 each one child. Practically all patients reported freedom from the symptoms of which they had complained before operation, and general health and strength were good.

CONCLUSIONS

1. Fibromata of the ovary may occur at any age after puberty; they comprise 3.5 per cent of all ovarian tumors.
2. There may be comparatively few symptoms and the tumor may be present a long time without the patient's knowledge.
3. Ascites and tumor of the pelvis do not necessarily mean abdominal malignancy.
4. The treatment is surgical. All ovarian tumors should be operated on as soon as diagnosed.
5. The prognosis is good.
6. Menstruation is usually regular and normal in amount as could be expected following unilateral ovariotomy.
7. Normal pregnancy may occur in patients of child-bearing age, when only one ovary, or one ovary and one tube, has been removed.

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INTRACRANIAL AEROCELE FOLLOWING A FRACTURE OF THE SKULL

Report of a Case with Review of the Literature

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DURING the past few years cases of intracranial aerocele have been reported from time to time with increasing frequency. With the improvement in the methods of X-ray diagnosis and the routine roentgenography of head injuries, more and more cases of this interesting condition will be noted. In view of this fact it seems important that the terminology to be applied to the condition be definitely settled. Reliable authorities have spoken of the condition as a pneumocranium. To this we object. "Pneumocranium" has no definite meaning. "Pneumocele" or "aerocele" connotes a swelling or tumor containing air. "Intracranial" localizes the position of this air. "Traumatic" might be added to the title as the condition is invariably preceded by an injury to the cranial bones.

In reviewing the cases of intracranial aerocele for the past few years, several facts bearing upon its etiology and development stand out clearly. Trauma of the frontal region of the skull involving the sinuses, a compound comminuted fracture resulting in a tear of the dura which permitted the ingress of the air was the commonest cause of the condition. But any compound fracture with a dural tear, whether the sinuses are involved or not, may be followed by the formation of an aerocele. The air is always intradural. In none of the ten cases embodied in this report was the presence of the intracranial air suspected until shown by a roentgenogram. In 6 of these cases the aerocele developed insidiously and was found by X-ray at intervals varying from a few days to several months after injury. The original injury was comparatively trivial and only the persistence of cranial symptoms after the accident suggested the necessity for another roentgenogram. In the earlier cases the finding of the area of decreased density due to the air confused the X-ray diagnosis, as its exact significance was not at once appreciated. Fortunately for us, a similar case had occurred in this clinic about 18 months previously and the presence of air as the cause of the shadow had been confirmed at operation and autopsy. In view of this experience and with the knowledge gained from ventriculograms, the meaning of the shadow cast by the air was at once apparent.

The case we report follows the general type in most particulars.

A. C., male, age 19, entered the University Hospital on the service of Charles H. Frazier on March 28, 1921. While driving his automobile a collision occurred and he was thrown from his car, striking upon his forehead and face on a macadam road. Past medical, family, and social history unessential. On admission patient was unable to carry on a clear conversation; he was mentally confused and very restless. A large hæmatoma was present on left forehead with brush burns and a small abrasion over right eye. The eyes showed no ptosis or extraocular palsies; the left pupil was slightly larger than the right; no nystagmus; eye grounds negative. There was much bleeding from the upper portion of nose, the blood dropping down into the pharynx. The mouth was negative. There was no bleeding

TABLE I. SUMMARY OF CASES OF MOCTLE REPORTED IN PAST FEW YEARS

No.	Author	Age	Sex	Nationality	Date	Duration of Illness	Neurological Examination and Diagnosis	Date of X-ray Diagnosis	Second X-ray Diagnosis	Operation	Autopsy Theatre Report
1	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious and fracture of right orbital plate. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
19	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
29	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
31	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
32	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
33	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
34	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
35	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
36	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
37	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
38	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
39	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
40	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
41	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
42	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
43	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
44	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
45	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
46	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
47	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
48	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
49	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]
50	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	Unconscious. Left hemiplegia. Left ptosis. Left internal strabismus. Diagnosis: Fracture of orbital plate and base of skull.	[illegible]	[illegible]	[illegible]	[illegible]

6	C. H. Horrax '07	19	I	Collision between auto and trolley	Lacerations over left orbit	2	Fractured skull	None at first. 3 months later 1. Weakness R. 7th (2) Blindness O. D. (3) Deafness R. (4) Loss of smell (5) Indications of damage to frontal lobes witzelsucht. Cranial defect over left frontal region	1st X-ray immediately after injury. Compound comminuted and depressed fracture of skull reaching from vertex slightly to L. of midline downward and forward and through L. orbit. Linear fracture extending backward to occiput, forward through both orbits and presumably through base of skull	3 months later X-ray showed area of decreased density over L. frontal region from near vertex down to left orbit. On comparison with plates taken 2 months before and one month after injury same area seen. Second plates show in addition lobulated shadow resembling a mass of bubbles seen under bone defect. This shadow extended backward into cerebral tissue for a considerable distance. Origin of air: crack in frontal sinus	None	No operative indications	Recovery
7	Doyle ? and Spiller '8	32	M	Auto accident	?	Yes (dead 3 days)	Fractured skull	Taining spell. Loss of memory. Sphincter loss became stuporous and developed signs of intracranial pressure	3 months after injury X ray showed fracture running into frontal sinus from left temporal region and collection of air in left temporal region			operation indicated to allow escape of air. Trephined in left temporal region and air escaped on opening dura with hissing noise. Died 6 days later	Necropsy. Clot between dura and bone dura and cortex. Air escaped from cyst size of hen's egg. Dura lacerated over cribriform plate of ethmoid. Probe passed from base of anterior fossa into nose. Bony roof of orbit bulged toward cranial cavity
8	Cotte (9)	?	M	Fall	Laceration about nose and fore head	Yes	Fractured skull	Disoriented and had difficulty in speaking	None at time of original injury. Several months after injury X ray showed a large frontal area of decreased density	None		Presume to relieve signs of increased intracranial pressure and subsequently a cranioplasty to repair defect caused by original injury	Patient refused further operation. On discharge complained of a gurgling sound on shaking his head. A free flow of cerebrospinal fluid was noted from nose prior to second operation
9	H. M. Imboden '10	62	M	Blow from hammer	Lacerations	Yes	Fractured skull	None. Recovered	Frontoparietal region showed a depressed fracture of skull beneath lacerations. X ray, Oct. 11	On Nov. 8 following, dizziness and an epileptiform convulsion. X rayed again and area of decreased density seen beneath area of original fracture. A third X ray Dec. 2 showed no area of decreased density	Depressed fracture raised. Several pieces of loose bone removed. Dura lacerated and repaired with rubber tissue. Wound healed but a sinus remained for a month. Cleared up when another piece of bone came away		Patient recovered. No symptoms noted referable to injury
10	Glenard and Aimard '11; Barbe and Glenard '11	28	M	Bullet	Penetrating wound in fronto temporal region	Yes	Through and through bullet wound. Both tables involved at entrance and exit	None made. Wound took 2 months to heal and cerebrospinal fluid fistula developed. This healed later and fluid leaked from the nose	2 months after injury X ray showed large area of decreased density above cranial defect. Fluid level noted and a splashing sound could be heard when patient shook his head	5 months after injury area of decreased density due to air had disappeared. Neurological examination at this time negative except for slight loss of memory and headaches localized to cranial defect	None		Patient died of influenza 6 months after injury. Autopsy showed a well-defined cyst in frontal lobe and tip of temporal lobe. Dura firmly adherent to skull. Cavity contained 25 c.cm. of clear yellowish fluid. Cyst lining resembled ependyma of ventricle

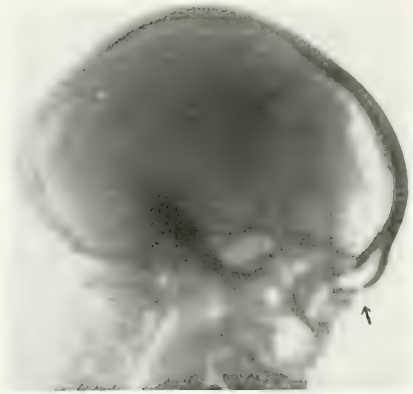

Fig. 1. Roentgenogram taken on admission showing aerocele in frontal region. Arrow points to point of fracture into and through the frontal sinus.

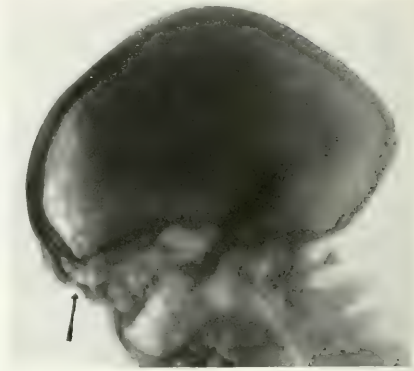

Fig. 2. Roentgenogram taken two days after that shown in Figure 1, showing air still present but in decreased amount. Arrow points to line of fracture.

from the ears; the drums were negative. The neck showed no rigidity; otherwise negative. Examination of chest showed nothing abnormal except for some pain over the left upper ribs. Examination of abdomen was negative; no tenderness, masses or rigidity. The arms showed no weakness, reflexes normal. Brush burn inside left arm. Crepitus and pain were found on outer side of the left tibia at the knee joints; otherwise the legs were negative. Achilles reflex present and equal in right and left. Patellar reflex normal in right, no Babinski or clonus.

Patient continued to bleed from nose and pulse went up to 112. He vomited twice large quantities of blood. About 5 hours after the accident he stopped bleeding.

Blood examination showed red corpuscles 4,890,000; white corpuscles 28,600; *Type II.*

Patient was delirious all night. Lumbar puncture showed pressure of about 2 millimeters of mercury; fluid was very bloody.

March 29, 1921, X-ray report showed a fracture through frontal sinus region and large traumatic intracranial aerocele; also a fracture of head of tibia.

March 31, 1921. Blood examination showed red corpuscles 3,040,000; white corpuscles 9,200; hæmoglobin 80 per cent. The condition remained about the same. There were no signs of paralysis anywhere. Lumbar puncture showed pressure of 20 millimeters. Nine cubic centimeters of fluid removed and pressure fell to 12 millimeters. The fluid did not contain as much blood as it did yesterday, but patient is more restless than yesterday.

April 1, 1921. X-ray examination gave about same appearance as at previous examination. There was no increase in air.

In view of the fracture through the frontal sinus and the aerocele it was decided to operate. Even though the plates taken 3 days apart showed no increase in the amount of intracranial air, we felt that an attempt should be made to find and close the tear in the dura through which the air had entered. It was feared that infection might pass in from the frontal sinus, producing meningitis.

April 2, 1921. A T-shaped incision was made. The vertical limb of the T was made in the mid-line, the horizontal limb about 7 centimeters above the eyebrow. Triangular flaps were reflected upward and downward. Osteoplastic flap was raised after drilling 4 holes in the 4 corners of the wound. The osteoplastic flap was raised without difficulty and the dura was found to be normal. On incising the dura, air escaped in small quantities followed by cerebrospinal fluid under considerable pressure. The horizontal edge of the flap had been placed too high so that it was not possible to dislocate the frontal lobe sufficiently to reach the floor of the anterior fossa or the dura over the antero-inferior part of this lobe. In attempting to do this, severe bleeding was encountered in the anterior central portion of the dural incision. This was controlled with considerable difficulty by tamponing and it was found necessary to leave the tampons in the wound and close it with them in place.

Patient's condition was poor but following blood transfusion condition was satisfactory.

A second operation became necessary to remove the tampons.

Exploratory craniotomy, April 5, 1921. Ether anæsthesia, endopharyngeal. The stitches were

removed. The vertical incision was extended down to brow, flaps reflected, and wound covers applied. Bone flap was removed and placed in warm normal saline solution.

Puncture of the dura was made in the frontal region and a few bubbles and a dram or two of straw-colored fluid escaped. However, there was no evidence of any large collection of air, and we assumed that the communication between the sinus and the nasal chamber had been obliterated. The dural puncture was closed and, little by little, all the tampons were removed without recurrent bleeding. While the wound was being closed it was irrigated with hot normal saline solution.

The postoperative recovery was rather tedious but uneventful. Just what caused the dural rent to close we do not know. It was not seen at either operation. Possibly some of the blood from the free hæmorrhage encountered filtered down to the base of the frontal lobe and plastered over the opening. Whatever the process may have been the air did not reaccumulate as subsequent X-rays showed.

April 15, 1921, final X-ray report: The bone flap is in good position. No area of decreased density due to air is to be seen.

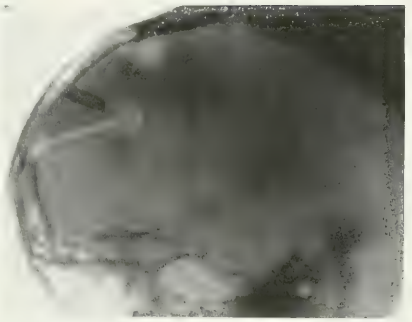

Fig. 3. Roentgenogram taken two weeks after operation showing absence of air in frontal region under bone flap.

In the light of our experience with this case and from consideration of the case reports from the literature, we feel that in all cases of compound comminuted fracture of the skull, especially of the frontal areas of the skull which may involve the basal sinuses, the possibility of an intracranial aerocele should always be considered. Even in the absence of an apparent skin laceration the fracture may be compound internally into the sinuses with a tear in the dura through which the air may be forced. If the air is not seen in the first X-ray, the roentgenogram should be repeated subsequently at intervals a month or more apart, particularly if signs of increased intracranial tension develop. The presence of a pneumocranium immediately after the injury is an indication for operation at once to attempt to close the dural tear, thus minimizing the danger of infection. If the air is unexpectedly discovered after 5 or 6 days, when the sinus may have spontaneously closed, and if on repeated X-ray the quantity of air shows no increase and is causing no symptoms, a policy of watchful waiting should be instituted. Air *per se* once the possibility of infection can be excluded is relatively innocuous; it will be absorbed and no harm result. The patient should be warned against coughing or sneezing, which might reopen the sinus and force more air into the subdural spaces. Urotropin should be administered. The nose should be douched gently with a weak antiseptic solution. In our case, if presented again with a similar condition, the propriety of surgical interference 4 days after injury with no (apparent) increase in the size of the pneumocranium would be seriously questioned. We should have operated immediately after the first X-ray made the diagnosis. The second plate should have told us that as the quantity of air had not increased the sinus was probably closed and that close observation to catch the first signs of symptoms which would require free drainage for their relief was sufficient. Unless these symptoms arise, operation is contra-indicated in late cases.

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A NEW METHOD OF GALL-BLADDER DISSECTION, WITH A CONSIDERATION OF THE SURGICAL ANATOMY[1]

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IN offering a new procedure in the dissection of the gall bladder, my purpose is to lessen the chances of injury to the blood vessels and bile ducts and to facilitate the removal of the gall bladder. Three factors necessary in order to reduce the operative risks, are: first, a thorough knowledge of the anatomy and of the variations frequently found in this region; second, a knowledge of pathological variations; and third, an improvement in operative technique to avoid accidental injury to important structures.

That the present methods used in the removal of the gall bladder are not satisfactory is evidenced by the frequent injuries of the bile ducts and the occurrence of hæmorrhage. In a review of the cases of operative injury to the bile ducts, Eliot stated that the most frequent cause was due to injury during cholecystectomy. This has been the experience of other surgeons. Balfour and Ross state that out of 16 cases of biliary fistula due to injuries of the bile ducts at operation, 13 had had the gall bladder removed.

Other sequelæ of bile-duct injury are well known. Hæmorrhage may be due to a failure in clamping, or tying the cystic artery or its branches. A bloody field is also a cause of many injuries to important structures. Ligation of the hepatic artery or its branches has been pointed out clinically by Kehr, Thoele and others to cause serious changes in the liver, and Thoele states that necrosis of a lobe of the liver is a fairly constant result from ligating its corresponding arterial branch and necrosis of the entire liver may result from ligating the hepatic artery unless there is abundant collateral circulation. He found it possible, experimentally, in some cases to suture the omentum to that lobe where the artery was ligated and establish a collateral circulation. The ligation of the hepatic artery may not cause fatal changes in the liver of carniverous animals, but in the herbiverous, it usually results in death (Behrend, Mayo).

The two accepted methods of gall-bladder removal are: one, from the fundus toward the cystic duct; the other, from below up. The latter method was popularized and has been most widely used following the recommendation of Mayo, Moynihan, and Erdmann. This has been the method chosen by most operators where there is only slight disease in or around the gall bladder.

In the presence of extensive changes, as empyema, œdematous friable tissues, or extensive adhesions around the bile ducts, one is confronted with a difficult dissection and much danger of injury to important structures. Here all have agreed that it is wise to abandon an attempt to dissect by the classical method from below up for one of the following procedures. If it seems wise to remove the gall bladder, it may be dissected from the fundus down, or where that is difficult, one may split the gall bladder, and follow the mucosa down to the cystic duct, and into the common duct (Mayo, Bevan). Stripping away the mucosa may occasionally be chosen (Mayo). A subserous dissection by splitting a thickened serosa may be done (Kehr, Courvoisier, Andrews). The performance of gall-bladder drainage may be preferred to cholecystectomy in difficult or selected cases.

Judd, Yates, and Masson state that they use the older method of dissection from the fundus down only in the more difficult cases. However, on account of the number of accidents to the bile ducts and occasional hæmorrhage from the cystic artery, there has been a failure not only in adoption of the newer method from below up by all surgeons (W. Meyers), but there has been a reversion by some men to the routine use of the older method of dissection from the fundus down, because they believe it to be safer (Seelig). Objections to this dissection from the fundus down are several. There is bleeding from branches of the cystic artery, which are re-

Read before the Chicago Surgical Society, November [illegible]

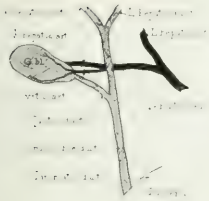

Fig. 1.

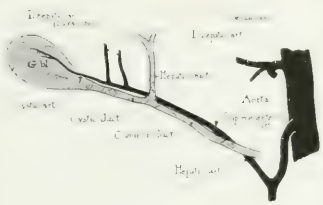

Fig. 2.

Fig. 3

Fig. 1. The most frequent of the four relations classed as normal where the hepatic branch to the right lobe of the liver passed posteriorly to the bile duct and then gave off the cystic artery. This occurred 14 times. In the second relation the hepatic branch passed anteriorly to the bile ducts 5 times. In the third, the cystic artery arose at the left of the bile ducts and passed posteriorly to the bile ducts 3 times. In the fourth, the cystic artery passed anteriorly 6 times.

Fig. 2. A common anomalous origin of the cystic artery and of the branch to the right lobe of the liver from the superior mesenteric artery, four cases. In two, this included the only artery to the right lobe of the liver, while in the other two there was a branch from the hepatic artery. With this relation of the right hepatic artery and the common duct the artery might be cut in operating upon the common duct.

Fig. 3. The anomalous branch to the right lobe of the liver giving off the cystic artery arises directly from the aorta. It passes posteriorly to the portal vein as did two of the hepatic branches arising from the superior mesenteric artery.

peatedly cut, and from the liver, and anastomosing blood vessels. This creates a bloody field during the most difficult part of the dissection. Traction cannot be made safely on this freed gall bladder on account of the danger of tearing the cystic artery, pulling off the cystic from the common duct, or of clamping the distorted common bile duct with the cystic duct (Douglas, Phemister). The presence of a normally attached gall-bladder fundus for elevating and steadying the liver and bile ducts is not always properly appreciated. Where pathological changes are present, the difficulties in the dissection from above down, are increased.

Objections to dissecting from below upward are due to difficulty in isolating the cystic duct and artery, without injury to other bile ducts and important blood vessels. This method is exceedingly dangerous because of the frequent anatomical and pathological variations of the bile ducts, the neighboring blood vessels, and also those variations which may be due to the surrounding viscera. It becomes very difficult and dangerous in the presence of adhesions, a thick, friable and distended gall bladder, a short or dilated cystic duct, and in a different exposure, due to a thick abdomen or overhanging liver.

A year and a half ago, I evolved this new method under difficult conditions with an œdematous, friable, and thickened gall bladder filled with stones, showing beginning gangrene. I have found it satisfactory in the presence of a variety of pathological changes. In addition to pathological changes, where I have found the procedure less difficult than the classical method, there must be a sound anatomical basis for it not only to avoid injury to the normally placed bile ducts, blood vessels, and viscera, but to the frequently variable relations and anomalies among them.

SURGICAL ANATOMY

There are four relations between the cystic artery and the bile ducts which are so frequent that they may be called normal: first, and most frequent, the hepatic artery or branch to the right lobe of the liver with normal origin passes posteriorly to the bile ducts and gives off the cystic artery at their right, as was found 14 times (Fig. 1); second, the hepatic artery passes anteriorly before giving origin to the cystic artery, found 5 times; third, the cystic artery arises at the left of the bile ducts and passes posteriorly to them, 3 times; fourth, the cystic artery arises at the left, and passes anteriorly to the bile ducts, 6 times.

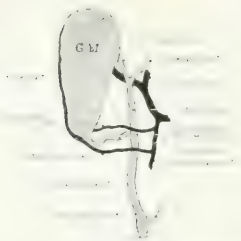

Fig. 4.

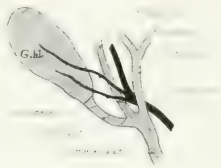

Fig. 5.

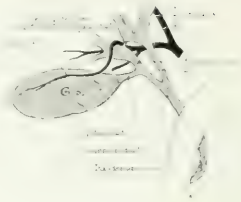

Fig. 6.

Fig. 4. A rather commonly described anomalous origin of the cystic arteries from a branch not going to the liver, the gastroduodenal artery. This origin was found once in my series. The cystic duct opens posteriorly into the hepatic duct.

Fig. 5. The cystic duct opens into the right hepatic duct which might easily be caught with the cystic duct mistaking the left hepatic for the common hepatic duct. There is usually no anastomosis as occurs in Figure 6 to compensate for an injury to the right hepatic duct.

Fig. 6. Anomaly of the bile ducts. There is a double hepatic duct with a communication at the upper end. The cystic duct opens into the right duct, which might easily be caught and injured.

In the remaining 9 instances of the 37 cases studied, there was a very unusual origin, number, or course of the cystic artery, and they were classed as anomalies. The cystic artery arose in these cases at the left in 3, and crossed the bile ducts anteriorly in all 3 cases. In 7 instances the cystic artery arose at the right of the bile ducts, while the branch to the right lobe of the liver from which it came, passed the bile ducts posteriorly in all cases. In one instance of double cystic artery, one artery arose at the left of the bile ducts and crossed anteriorly from a left hepatic branch, while the other artery arose at the right of the bile ducts from the right hepatic, which came from the superior mesenteric artery.

Since with the origin of the cystic artery at the left of the bile ducts, there would be less danger of injury to its source, the main arteries which supply a lobe or the entire liver, than if these vessels passed to the right of the bile ducts, the frequency of these relations was determined.

In 12 cases the cystic arteries arose at the left of the bile ducts from some hepatic branch. In 3, the arteries passed posteriorly, and in 9 the cystic arteries passed anteriorly to the bile ducts, but in 6 of these the right hepatic branch gave off the anterior cystic artery, and then passed posteriorly to the bile ducts.

The cystic arteries arose at the right of the bile ducts in 26 cases. Here in ligating the cystic artery, there would be a greater possibility of injuring the arterial blood supply which passed to the liver. These blood vessels to the liver, giving origin to the cystic artery at the right of the bile ducts, crossed anteriorly 5 times and posteriorly 21 times. In 20 instances, the vessel which gave off the cystic artery was the only branch to the right lobe of the liver, 4 of these having an anomalous origin. In 3 other instances, where the right hepatic was anomalous in origin, there were accessory branches to the right lobe of the liver from the cœliac artery. In one instance, there were multiple normal right hepatic branches. In two instances the common hepatic artery passed to the right of the hepatic duct in close relation to the cystic duct, exposing itself directly to injury and might be mistaken for the cystic artery or clamped with the cystic duct.

Thus in over two-thirds of the cadavers dissected, there would have been danger of ligating or injuring a large hepatic blood vessel in ligating the cystic artery and duct, and in two of them, interrupting the blood supply to the entire liver.

Origin of the cystic artery from an anomalous hepatic branch which did not come from the cœliac artery occurred in 5 instances. In 4 of these the cystic arose from a right hepatic branch which came from the superior mesenteric artery (Fig. 2). In only two of these four cases were their accessory normal branches to the right lobe of the liver from the cœliac

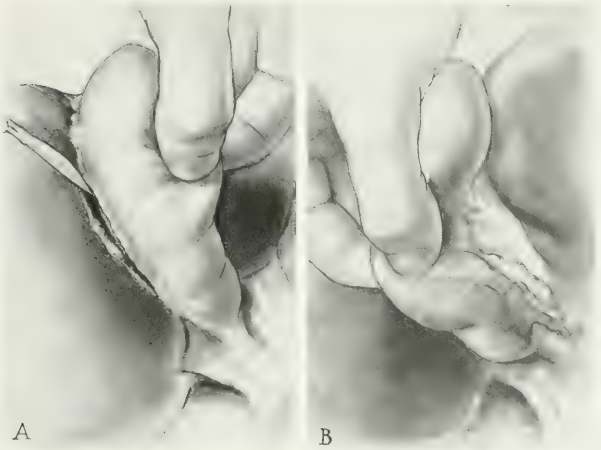

Fig. 7. a (at left). The incision at the side of the gall bladder near the pelvis where posterior dissection is started.

b. The gall bladder has been freed from the liver posteriorly in this region and from its left peritoneal attachment. An opening may now be made through the peritoneum on the left of the gall bladder. Any blood-vessel branches are ligated.

artery. In the fifth an accessory right hepatic artery arose from the aorta and gave off the cystic artery (Fig. 3).

In the 5 instances where a right hepatic branch arose from the superior mesenteric or aorta, it passed posteriorly to the portal vein 3 times and anteriorly twice.

The hepatic artery, one of its branches or the cystic artery, ran to the right of the common or cystic bile ducts and parallel for some distance in the edge of the gastrohepatic omentum in 5 instances. Where the hepatic branch arose from the superior mesenteric or aorta, it passed nearly the whole length on the right of the common duct and would be exposed to operative injury (Fig. 2).

The cystic artery was double three times in the 37 dissections, in the first of which there were two cystic arteries which arose from the gastroduodenal artery (Fig. 4); in the second, both came from the right hepatic artery (Fig. 5); in the third, one cystic artery came from the left hepatic branch, and the cœliac artery, while the other cystic artery came from an anomalous right hepatic branch originating from the superior mesenteric artery.

The cystic artery usually runs anteriorly to the cystic duct in its distribution to the gall bladder. Rio Branco states that near the region of the neck it divides into its peripheral branches.

Anomalies of the portal vein, which expose it directly to injury in operations on the gall bladder or ducts are unusual. However, Knight recently reports such an anomaly of the portal vein found in the dissecting room. The portal vein in this case was in front of the duodenum, common bile duct, and hepatic artery.

The gall bladder. There may be congenital absence of the gall bladder, displacement to the right or to the left, or variation in size and shape (Descomps, Kehr). The most frequent displacement is attachment to the left lobe of the liver. Pathological changes may occur, resulting in all types of deformity or displacement. Brewer states that usually one-third to one-fourth of the surface of the gall bladder is not covered by peritoneum, but that in 5

Fig. 8. The inferior portion of the gall bladder and cystic duct have been entirely freed from the liver and are exposed posteriorly. The lower end of the gall bladder is rotated to the left, and the cystic duct is enucleated from the peritoneal fold.

per cent of cases there is a distinct mesentery to the gall bladder.

The bile ducts. There is relatively less variation, fortunately, in the bile ducts than in the blood vessels. In only one of 100 cases did Brewer find any variation in the number of the bile ducts. Here there were two auxiliary ducts from the right lobe. He did find considerable variation in the length of the various ducts. One or even all of the bile ducts have been found to pass directly into the hepatic side of the gall bladder (Kehr).

Mayo has pointed out the importance of remembering that the cystic duct has its origin on the posterior wall above the lowest point, and that the pelvis of the gall bladder usually overlaps the cystic duct on its inferior and inner aspects. Quite frequently there is a little fold of peritoneum connecting the pelvis of the gall bladder with the gastrohepatic ligament over the common duct, forming a small suspensory ligament.

Eisendrath worked out, especially, the types of junction of the cystic and hepatic ducts. He found four types: the acute angle, the short parallel, the long parallel, and the spiral types. In my study of the lengths of the various ducts, I found that the cystic duct averaged 2.5 centimeters in length in 20 cases; in 35 cases, the hepatic duct averaged 3.0 centimeters and the common bile duct 6.24 centimeters in length.

There was great variation in the point of insertion of the cystic duct. In a study of the junction of the cystic and hepatic ducts, I found the junction forming an acute angle in 26 cases, an obtuse angle in 3 cases, and found 8 cases to be of the spiral type. In the spiral type the cystic duct opened on the posterior of the hepatic duct 7 times, and in the other case, passed over the hepatic duct and entered on the left side. In one case there was what appeared to be a double hepatic duct with a communication above and the cystic duct entering the right one (Fig. 6). In one case the cystic entered the right hepatic branch above its junction with the left duct (Fig. 5). This left hepatic branch might easily be mistaken, at operation, for the common hepatic bile duct, and the right hepatic branch clamped with the cystic duct.

There was one instance of an accessory anomalous left hepatic duct. This emptied into the common bile duct below the junction of the cystic duct.

TECHNIQUE OF THE NEW PROCEDURE IN THE DISSECTION OF THE GALL BLADDER

An adequate exposure is necessary. Greater mobilization of the liver may be obtained by cutting the round ligament. A distended gall bladder may first be aspirated and partially collapsed. This will permit of traction on the fundus and pelvis, if desired. However, a thickened, friable wall will not collapse.

In beginning the dissection, the gall bladder is held in the left hand, and an incision is made through the peritoneum along the right side near its liver attachment. This incision through the peritoneum starts usually just above the pelvis and extends for about 2 inches along the body of the gall bladder parallel to the liver margin (Fig. 7, *a*). By

lifting the gall bladder, and rotating it to the left, a line of cleavage is easily formed posteriorly. Following this line of cleavage, the gall bladder is separated from the liver or connective-tissue bed in this particular region. The separation may be done with the finger, or it may be done by inserting and spreading a blunt hæmostat, at the same time lifting up and rotating the gall bladder to the left. Where the tissues are œdematous and the gall bladder thickened and friable, the tissues separate very readily.

After freeing the posterior wall of the gall bladder in this region, it is partially rotated out of this opening and peeled away from its left peritoneal fold (Fig. 7, b). The chief branches of the cystic artery pass in this left peritoneal fold near the neck of the gall bladder. Some branches may be ligated when an opening is now made in this freed fold of peritoneum on the left side of the gall bladder. If possible, a flap of the peritoneum, one-half to three-fourths of an inch wide, is left attached to the liver. This frees a small portion of the gall bladder just above the neck entirely from the liver. The opening permits easier manipulation of the gall bladder for further posterior dissection toward the cystic duct.

There have been several variations used in the technique of freeing the left peritoneal fold in the region above the gall-bladder neck and ligating the branches of the cystic artery, due to variations in the anatomy. Where the cystic artery branches off well above the gall-bladder neck, the larger branches may be ligated in cutting an opening through the left peritoneal fold. But where it is avascular it may be perforated by a blunt hæmostat, which is spread apart and the opening enlarged. The branches of the cystic artery which pass in the peritoneum over this region of the neck, may be ligated separately or with the mesentery after enucleating the cystic duct. Where dissection of the gall bladder posteriorly and below may be done easily by rotating it, the entire left peritoneal fold may be left intact until after the dissection of the cystic duct.

After freeing that portion of the gall bladder in the region above the neck it is lifted up and rotated away from the right side. This exposes the lower uncut portion of the right

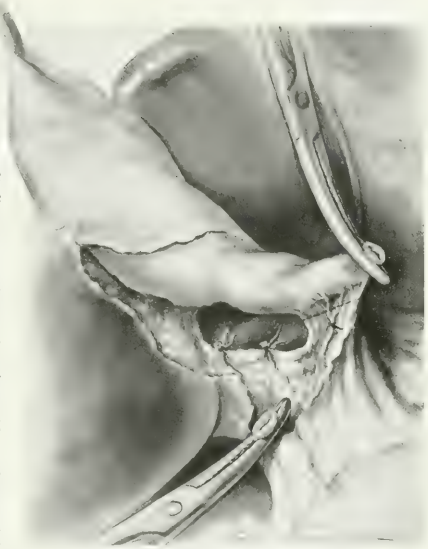

Fig. 9. Traction on the cut upper end of the cystic duct exposes the uncut portion of the left peritoneal attachment to the neck of the gall bladder which contains branches of the cystic artery. This peritoneal fold and the cystic artery branches are ligated distally, well out of the danger zone. The peritoneal attachment is cut through, along the dotted line, freeing the lower end of the gall bladder.

peritoneal attachment which extends over the pelvis of the gall bladder. The lower portion of the gall bladder and pelvis are first separated from their posterior liver or connective-tissue bed from above by blunt dissection and the right peritoneal fold is then cut as the dissection is carried down. The neck of the gall bladder is followed posteriorly to the cystic duct, which is approached from above by traction on the gall bladder, and rotation to the left which exposes the posterior wall. The posterior attachments of the lower end of the gall bladder and cystic duct are usually formed by loose connective tissue, making separation easy. This dissection gives full view of the posterior neck of the gall bladder and the cystic duct.

The anterior peritoneal folds are intact below in the region of the blood vessels and

bile ducts. Consequently, if adhesions or anomalies are present, they may be left undisturbed. The cystic duct is enucleated from the lower portion of the left and anterior peritoneal fold. This may be done by means of blunt dissection with a curved hæmostat, while the gall bladder is held forward and rotated to the left, exposing the posterior structures (Fig. 8). The cystic duct is now freed as far down as is desired, double clamped and cut. Traction upward upon the clamp attached to the cystic stump will partially enucleate the lower end and neck of the gall bladder from this left peritoneal fold. With rotation to the left of the neck of the gall bladder and this partial enucleation of the cut cystic duct, there is formed quite a distinct, uncut fold of peritoneum on the left at the lower end of the gall bladder (Fig. 9).

This fold of peritoneum, which usually contains the chief branches of the cystic artery may now be caught with one or two hæmostats close to the gall-bladder neck and either double ligated or a transfixion ligature used. The distal ligation of the branches of the cystic artery in this manner makes it unnecessary to dissect out the main artery in the danger zone. Section of this band of peritoneum near the gall bladder entirely frees its lower end. If a hæmostat or ligature slips, this mesentery containing the branches of the cystic artery is long enough and far enough away from the danger zone so that it may be picked up again without injury to any vital structures.

There is no danger of injuring the hepatic or common bile ducts or abnormal structures because the gall-bladder neck is first exposed, and this is followed down posteriorly along the cystic duct, by lifting the lower end of the gall bladder, and rotating it to the left. During the dissection, traction may be made on the still attached fundus, the freed circumference of the gall bladder, and later upon the stump of the cystic duct in order to give better exposure and to assist in the separation. After the lower end of the gall bladder is freed, the upper part of the body and fundus are separated from below up. From my observations, the large and chief anastomosing branches from the liver are usually in this upper region. A flap of peritoneum may be left at the liver margin, in order to cover the raw surfaces of the liver.

ADVANTAGES

There are several advantages in this lateral posterior approach, followed by posterior dissection of the gall bladder, first toward the neck:

1. There is a lessened danger of injury to the bile ducts. This also obtains in the presence of variations in anatomy and in difficult cases with pathological changes, due to the complete and easier dissection of the gall bladder posteriorly down to the duct.

2. There is less danger of injury to the blood vessels going to the liver.

3. The cystic artery is ligated peripherally at its branches. An escaped branch of the artery will not retract into the danger zone and may easily be picked up.

4. There is a dry field.

5. The dangers from hæmorrhage by a torn cystic artery and injury of the bile ducts from hurriedly applied hæmostats are avoided.

6. The gall bladder is under complete control.

7. Aside from the safety of this method of gall-bladder removal, I find it easier mechanically than any other method.

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INTESTINAL RESECTION IN MASSIVE UMBILICAL HERNIA[1]

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THERE are few conditions that appear more hopeless than certain of the enormous, irreducible umbilical hernias that occasionally come under the surgeon's observation. Coley has said that "The large umbilical hernia in the adult is one of the most difficult of all varieties of hernia to treat, and its proper handling requires the exercise of the greatest judgment." Whether we should operate on the large hernia of this type, containing most of the omentum with many loops of the intestine bound together by numerous adhesions, is a question on which opinions still differ. Until very recently we have been advised against operating in such cases, on the ground that the mortality is necessarily great and that recurrence is the rule.

In the section on hernia in Keen's *Surgery* is depicted a large umbilical hernia that is considered inoperable and yet is no larger than several that have recently been treated successfully by surgical operation.

In a series of 433 cases of hernia that have come under my observation in the past 6 years, 28 have been umbilical, and 5 of these might readily have been considered inoperable. Recently a patient with an enormous, irreducible umbilical hernia of 25 years' duration came to the hospital, suffering from acute obstruction. An extensive intestinal resection seemed the only solution. The prompt and satisfactory result that was obtained following an excision of the omentum, cæcum, and ascending and transverse colons with 7 feet of the ileum, lead to the adoption of free intestinal resection in several subsequent cases that presented technical difficulties of similar proportions.

Three such patients have been operated on recently and all have recovered so satisfactorily that I have been encouraged to seek others with like conditions of seeming inoperability.

Case 1. Miss. S. D., age 67, was admitted to the hospital December 30, 1921. She had excellent health until the age of 45 when she was in a hospital for several weeks suffering from influenza which, she reports, seemed to "settle in her lungs" and was attended by paroxysms of exhausting, non-productive cough. From this time she had had "chest colds" every winter with severe cough lasting usually 6 to 8 weeks. The patient attributes her hernia to the strain incident to the first attack of coughing at the age of 45. She first noticed a small bulging at the umbilicus which gradually increased in size, due to the strain of subsequent coughing, until the hernia attained its present gigantic proportions. With the onset of the hernia 22 years before came attacks of "indigestion." As described by the patient, there

[1] Read at the fourth annual meeting of the Association of Resident and Ex-Resident Physicians of the Mayo Clinic, Rochester, Minnesota May 30, 1922.

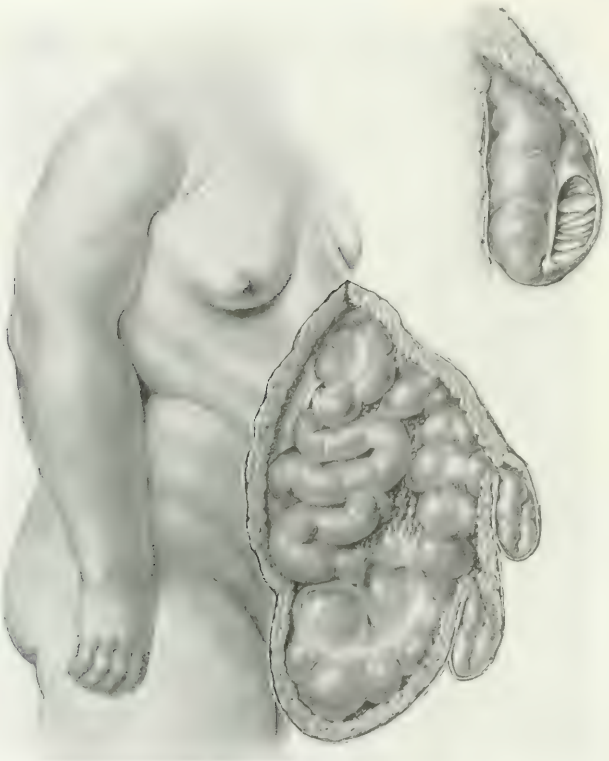

Fig. 1. Case 1, Miss. S. D. Enormous irreducible umbilical hernia of 25 years' standing with acute intestinal obstruction. Insert shows loop of ileum in secondary loculus with obstruction resulting from angulation and the impaction of several prune stones.

seemed to be an area of pain in the region of the umbilicus which ascended to the stomach and caused severe epigastric distress. In the course of a few years these attacks became more frequent and more severe occurring every 2 or 3 months, and were attended by vomiting. The present attack began 5 days ago with severe pain in the abdomen and with obstinate constipation. Enemata and cathartics were ineffectual. Three days before, patient began vomiting, first, the contents of the stomach and then fæcal material; this had persisted almost continuously.

On physical examination a huge hernia was found, extending from the ensiform cartilage to midway between the umbilicus and symphysis pubis. The hernial mass protruded about 50 centimeters from the anterior abdominal wall and consisted apparently of three lobes, all contained in the hernial sac and covered by skin and varying thicknesses of superficial fat. There were several areas of tympanitic resonance, which contained bowel distended with gas, while flatness on percussion was elicited in other areas and were firm to the touch. The hernia was roughly 60 centimeters in breadth and it appeared to be strangulated.

The transverse and ascending colon, cæcum, and about 280 centimeters of ileum were resected and end-to-end ileocolostomy performed. Examination of the specimen revealed a collection of seven prune

stones packed in a loop of ileum and causing complete obstruction.

Two days after the operation, the patient developed an intense diarrhœa. The stools were liquid, light brown in color, and contained proteolytic ferments of the pancreas and intestine, as they produced a marked digestive action on the buttocks. From the third to the twelfth day, stools became more frequent and involuntary, averaging 20 in 24 hours. On the twelfth day, rice gruel (10 per cent) was added to the general diet. Sixteen ounces were given every 24 hours for about 5 days. The constipating effect of rice and boiled milk undoubtedly exerted a slight influence in checking the diarrhœa, since from this time on the patient had fewer bowel movements, they were of greater consistency and the control was better. At the time the patient was dismissed, the stools were still liquid, averaging two in 24 hours. Coarse vegetables and fruits were found unchanged in the stools, particularly green and partially cooked vegetables. From time to time spinach, celery, lettuce, carrots, corn, and beans cooked in vegetable soup were found in the stools unchanged. Bread and stewed or boiled meats and well cooked vegetables containing no cellulose, for example, mashed potatoes, were all well digested. The patient was fond of milk and this was the mainstay of her diet while she was in the hospital.

The patient gradually improved for 3 months. Her two meals daily consisted mainly of milk, bread and butter or jelly, potatoes and macaroni. She ate very little meat after her operation and said that she had lost her taste for it. She had two attacks of severe, transient pain in the epigastrium and one attack of severe diarrhœa after drinking of iced ginger ale. Her bowel movements were still liquid, averaging two or three in 24 hours. She lost nearly 100 pounds in weight, but did not feel especially weak. She possessed an excellent appetite and thoroughly enjoyed her meals. In June, she resumed her occupation as a hand ironer in a public laundry.

Case 2. Mrs. A. B., age 38, was admitted to the hospital December 26, 1921. Fourteen years before the patient had a difficult labor, with her third child, and she believed the present trouble resulted from straining at that time. Twelve years before, she noticed a mass protruding from the umbilicus immediately after the birth of her fourth child. This condition became progressively worse until the umbilical hernia was about 40 centimeters in diameter and 20 centimeters in depth. Recently the mass had caused almost constant pain and had become irreducible. Bowels had been markedly constipated.

The patient was a very obese woman, not acutely ill, but apparently very uncomfortable from a large, irreducible umbilical hernia. The abdomen was pendulous, and there was no tenderness over the region of the appendix or gall bladder. The liver and spleen were not palpable. In the umbilical region was a large protruding mass, regularly oval

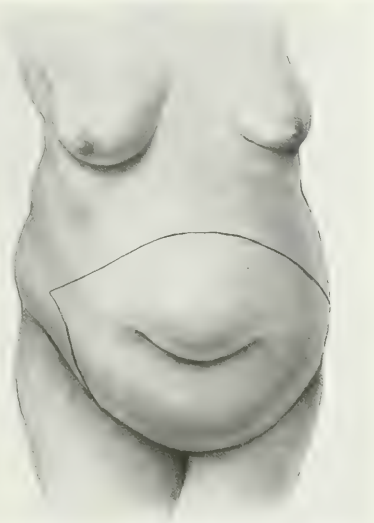

Fig. 2. Irreducible umbilical hernia. Skin incision for the isolation and resection of sac contents. Skin within lines resected.

in outline about 40 centimeters in diameter, and firm and resistant to the touch. In the lower portion of the hernia could be felt a hard tumor, rather freely movable and possibly attached to the uterus. Examination of the pelvis did not furnish information of value because of the patient's marked obesity.

December 28, the patient was admitted to the hospital for operation. The temperature was 100°, and analysis of the urine revealed a severe nephritis. Test of the renal function showed 39 per cent phthalein return in 2 hours. The leucocytes were 12,050 and the polynuclears 89 per cent. The Wassermann reaction of the blood was negative. Operation was postponed until the temperature had been normal for 8 days and the urine clear.

At operation, January 6, 6 feet of ileum with the cæcum and ascending colon were resected, and an end-to-end ileocolostomy was performed. One drainage tube was inserted beneath the skin to take care of fat necrosis. Examination of the specimen revealed that the mass that was believed uterine, was a dense area of reactive inflammation about an old suppurative appendicitis.

On the second day of convalescence the patient vomited and on gastric lavage a large amount of foul, yellow fluid was returned. The seventh day the patient was placed on a soft diet as nausea had

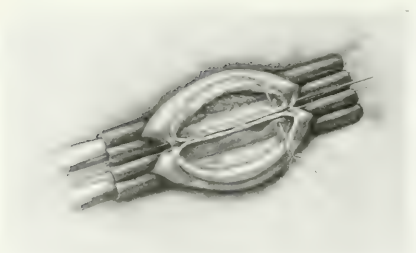

Fig. 3. The ileocolostomy. The ileum and colon approximated. Traction sutures in place. First stitch of posterior mucous suture line.

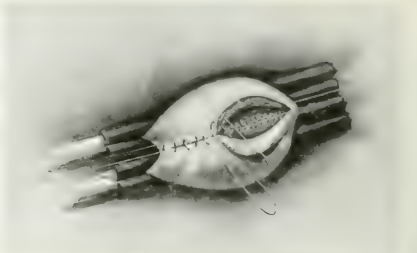

Fig. 4. Posterior suture line completed, anterior margins being inverted and serosa approximated. The operation is completed by a circle of interrupted silk suture through serosa.

entirely subsided. She developed a severe diarrhœa on the twentieth day and in addition to light, soft diet 10 per cent rice gruel was given with boiled milk and camphorated tincture of opium, 1 dram for four doses.

By the thirtieth day the patient's temperature was normal, and she was permitted out of bed. Her appetite was good and the diet was gradually increased. Bowel movements were still rather frequent.

On dismissal, February 10, the patient still had some trouble from "indigestion" with slight vomiting at times, especially on awakening in the morning. The wound had healed firmly. May 18, 1922, the patient returned for examination. She was doing much of her housework. The bowels moved two to three times a day. The appetite and digestion were very good though the patient had lost nearly 100 pounds in weight. She slept well, had no pain but some pruritis. There was a definite hernial defect on coughing, but the protuberance was readily supported by a binder. The question of radical herniorrhaphy was left to be considered at a subsequent examination in 3 months.

Case 3. Mrs. A. E., age 52, was admitted to the hospital, March 20, 1922. For 35 years the patient had been gradually gaining in weight. The abdomen had become more pendulous with each of thirteen childbirths. The condition had been aggravated since instrumental delivery 8 years before. During the past 2 years, the patient had been able to be on her feet for but a very short time, owing to the strain incident to supporting an enormous ventral hernia.

There had not been much pain in the abdomen: the bowels had never been loose but rather had been constipated and had moved only with the aid of cathartics. The appetite had always been good. For 2 years there had been nocturia two to three times, and at times urgency, especially when standing. The patient had an enormous pendulous abdomen. There was no definite hernial ring, but there was a wide diastasis of the rectus muscles with extrusion of the viscera and marked thinning of the abdominal walls.

At operation an intestinal resection was performed for wide rectus diastasis with large ventral hernia. Resection included the mesentery, cæcum, ascending colon, and a portion of the transverse colon, and about 2 feet of the ileum. Ileocolostomy was performed with end-to-end anastomosis. The weight of mass removed amounted to 1680 grams.

Four days after operation the patient developed a slight diarrhœa, but apart from being liquid, the stools were not abnormal. The number each day ranged from one to five. After the twenty-third day the stools averaged one daily. Occasionally the patient complained of discomfort after eating but this was relieved by sodium bicarbonate. The wound had entirely healed and the abdomen was readily supported by a binder. The patient was discharged from the hospital 35 days following the operation.

The easy confidence with which widespread intestinal resection can be carried out was demonstrated by Lane a few years ago when the operation was being popularly exploited in the treatment of so called intestinal stasis. Many very extensive intestinal resections are recorded in the literature and as one delves into the surgical archives he finds records of more and more widespread excision. There are instances of 2, then 3 or 4 feet of intestine removed and on to 5, 6, 7, 8, 10, and even 13 feet, until one is led to expect that he may ultimately unearth the records of some especially venturesome surgeon who has succeeded in anastomosing the pharynx directly to the anus. Littlefield has written of massive resections in postoperative

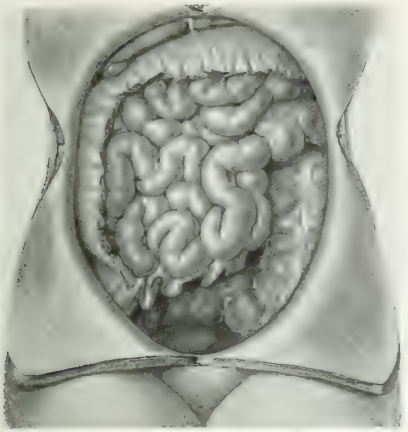

Fig. 5. Schematic drawing showing hernial mass resected and the ileocolostomy completed.

intestinal obstruction while Dunlap, Sherrill, Southam and Cranshaw record their experi-

TABLE I.—RESECTION OF ILEUM

Operator	Length of section resected, centimeters	Part resected	Result
Reder*	204	Ileum	Recovery
Dressmann (1899)	215	Ileum	Recovery
Shepherd (1898)	254	Ileum	Recovery
Kukula (1900)	247	Ileum	Recovery
Harris (1902)	249	Ileum	Recovery
Kirkwood (1915)	240	Intestine (Part of ileum)	Recovery
Payr (1902)	265	Ileum	Recovery
Zeidler (1906)	315	Ileum	Recovery
Miyake (1912)	238	Intestine (225 cm. ileum and 13 cm. colon)	Recovery
Long*	360	Ileum	Death
Obalinsky (1894)	365	Ileum and cæcum	Death in 28 hours
Turck (1914)	371	Ileum and colon	Recovery
Haggard*	380	Ileum and colon	Death in 11 days
Pauchet (1905)	400	Ileum	Recovery
Storp (1907)	515	Small intestine (Entire ileum and part of jejunum)	
Brenner (1910)	540	Intestine	Recovery

*Personal communication.

Fig. 6. Typical mass excised in irreducible umbilical hernia.

ences in resections in intussusception. Wood, of Edinburgh, recently reported a case of extensive resection of the ileum in a case of strangulated umbilical hernia. It has been generally agreed that at least one-third of the small intestine may be removed and the patient survive and remain in a fair state of health. Both Park and Moynihan have collected all reported cases of extensive resections of the intestine, but the total number is not large. There are in the literature approximately 48 cases of excision of very large portions of the ileum, the greatest being a removal of 540 centimeters by Brenner in 1910. A table of cases taken in part from Park and Moynihan and other sources dealing with resections of the ileum, is appended (Table I).

Operations upon patients with massive, irreducible umbilical hernias of many years' standing are among the most difficult. The condition is usually found in stout women of advanced years, who have borne many children and who often suffer from advanced cardiorenal disease. The repeated trauma-

tism, to which the bowel has been subjected during its sojourn of many years outside the abdomen, results in the formation of the densest sort of adhesions between the numerous loops of bowel and between them and the walls of the sac. The latter, usually multiloculated in an indescribably complex manner, often contain all of the colon, with the omentum, many feet of the ileum, and occasionally the stomach. Strangulation often occurs as a most grave complication.

The extensive and intricate dissection necessary to the complete isolation of the contents of the hernial sac from the margin of the abdominal defect through which the hernial elements protrude, with the ultimate resection and anastomosis, carries the operation well into the second hour and often into the third. The extreme care that must be exercised that the bowel, which in many instances is of tissue paper thinness, is not damaged during the dissection, often renders the procedure extremely tedious. The startling display of many feet of bowel, with its fat-laden mesentery and omentum often requiring the combined efforts of several assistants to prevent the prodigious mass from falling to the floor and dragging the patient with it, renders the scene somewhat ghastly and not unlike that presented in the average necropsy room.

Obviously every means at our disposal must be utilized in supporting the patient's vital forces during so formidable a procedure. The operation must proceed smoothly but without delay and the surgical personnel must carry on with that perfect team work that is now required in all well organized operating rooms. Great care must be observed during the division of the bowel that asepsis is maintained, the intestine being opened with the cautery and the anastomosis being performed with the thoroughness necessary positively to preclude subsequent leakage. The operation is preferably performed on a heated table while salt solution is administered freely before, perhaps during, and following the operation.

Should the patient's condition, especially at the end of a very extensive resection, contraindicate further surgery, closure of the hernia is left for a subsequent operation, the umbilical defect being temporarily closed with interrupted silk. Whether herniorrhaphy be performed at once or is reserved for a second operation, the closure is best effected according to the Mayo method which has so satisfactorily stood the test of time.

In the usual case of umbilical hernia the bowel can readily be returned to the abdomen after all adhesions have been freed. However, we are at present concerned with the hopelessly irreducible, massive hernia of many years' standing, often with partial or complete obstruction in which the intestine has sojourned outside of the abdominal cavity for so great a time as to have long since "forfeited its right of domain."

In operating on these cases I have been surprised at the slight shock such formidable procedures seem to produce. In the first case I looked aghast at the result of my work, especially when I saw two nurses leaving the operating room struggling with the weight of a large bucket containing most of the patient's colon, all of her omentum and about one-third of her ileum, and I felt that with so much of an important structure removed, it was somewhat of a question as to which object was entitled to the greater solicitude, the patient on the table or the contents of the bucket.

The bowel's long residence outside the abdomen proper, subjected as it is to repeated and unavoidable trauma, with the many years of constantly increasing traction upon the mesentery, apparently so inures the splanchnic system that the rough usage to which the intestine is necessarily subjected during the operation produces surprisingly little change in the patient's blood pressure.

I desire to emphasize the importance of carefully closing the hiatus in the mesentery on the completion of the anastomosis. Axial union between resection of divided bowel is, obviously, the ideal method of anastomosis and I feel that the general attitude of surgeons against end-to-end anastomosis between colon and ileum is not fully warranted. This is but an endorsement of Balfour who pleads for the end-to-end union rather than the lateral approximation, and I have followed

Fig. 7

Fig. 8

Fig. 9.

Fig. 7. Front view of patient who had suffered with large irreducible umbilical hernia with rectus diastasis which had been present more than 20 years.

Fig. 8. Lateral view of patient shown in Figure 7.

Fig. 9. Patient with irreducible umbilical hernia of 10 years' standing. Had previously been operated upon twice.

the technique of Lockhart-Mummery in the present series as well as in other cases of resection for obstruction and malignancy, with most satisfactory results.

My patients have reacted promptly from operation and by the third day seem in better general condition that the average person upon whom a cholecystectomy or hysterectomy has been performed. There is usually an annoying diarrhœa during the first few weeks; but this gradually subsides although the patient may continue indefinitely to have two or three stools a day. Except for this trouble, the patient seems but little worse for the loss of such a large fraction of her alimentary tract while the relief afforded by the removal of the great pendulous mass, which in one of my cases was so great that the patient was unable to walk, is very great and far offsets any annoyance resulting from the diarrhœa.

The small intestine, from the opening of the common duct, is derived from the mid-gut and from it is absorbed 90 per cent of the solids and over 50 per cent of the fluids of the intestinal tract. The colon to the splenic flexure, also derived from the mid-gut, takes up the remaining 10 per cent of solids and the rest of the fluids.

The loss of so large a segment of the absorbing portion of the alimentary tract in the removal of the ascending colon, and particularly if the resection extends far into the ileum, necessarily results in marked metabolic disturbances chiefly manifested by rapid and pronounced loss in weight. With my patients, this has occurred, amounting in one instance to nearly 100 pounds. However, as these patients are, as a rule, very obese the loss is something of an advantage. At least the patient's strength is maintained, the appetite and digestion remain excellent and,

except for the diarrhœa, the patient presents a picture of comfort and well-being in striking contrast to the ill health exhibited before being operated upon.

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DEPARTMENT OF TECHNIQUE

ASEPTIC RESECTION OF INTESTINE[1]

By E. D. HIGHSMITH, M.D., F.A.C.S., Atlanta, Georgia

ONE of the most baffling problems in intestinal surgery is the devising of a technique which will make it possible to do an end-to-end anastomosis which will not be followed by infection. Infection in intestinal surgery is caused usually by contamination from the contents of the bowel after it has been opened, and it is especially likely to occur after operations on the colon. To overcome infection—a matter of prime importance in such work—various methods of procedure have been used; the lateral intestinal anastomosis on the large bowel, the end-to-end anastomosis on the small bowel.

I think that it is generally admitted that a lateral anastomosis is physiologically and mechanically bad surgery, as the circular muscles of the intestine are cut and the ends overlapped and sutured together, thus producing a sort of splint which practically destroys peristalsis in this region. At the site of an end-to-end intestinal anastomosis, there is not the slightest stasis; while in a lateral anastomosis a blind pouch which cannot be emptied is left at either end of the overlapped area. The lateral anastomosis is therefore used not for its physiological advantage, but because most of the operation can be completed before the lumen of the bowel is opened, thereby lessening to some extent the dangers of contaminating the field of operation. However, lateral anastomosis is essentially an open operation, and therefore if it is possible to do an end-to-end anastomosis of either the large or small intestine with less danger of infection and in a shorter period of time, and to restore the parts nearer to the physiological normal, why should one resort to lateral anastomosis?

Last year in the department of experimental surgery of Emory University, a number of experiments in intestinal anastomosis were performed on dogs under general anæsthesia. The loop-clamp was devised which makes it possible

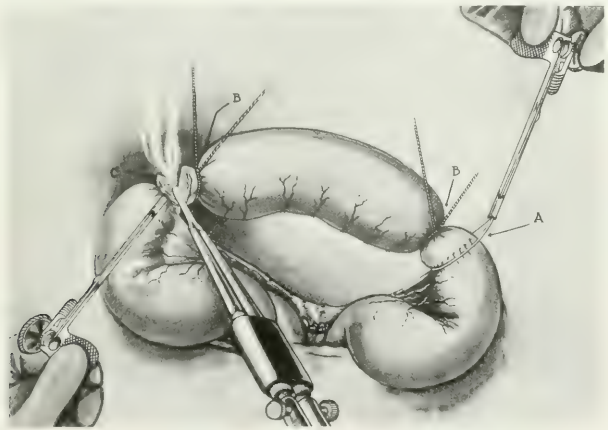

Fig. 1.

[1] Submitted for publication, September, 1922.

Fig. 2

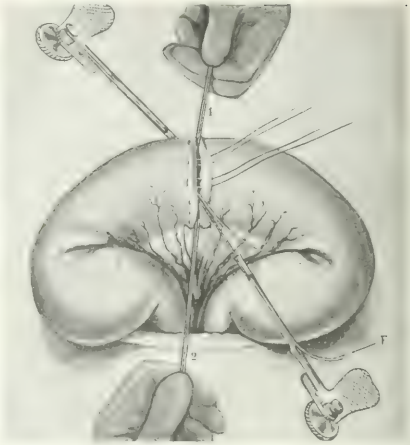

Fig. 4.

to do a blind end-to-end intestinal anastomosis. With this instrument, it is possible to hold the intestine closed while the diseased area is cut away by the cautery, the ends sutured together, and the operation practically completed before the clamp is released and the ligature slipped out. By the aid of traction sutures Figures 1, 2 and 3, the double diaphragm is pulled open.

TECHNIQUE

The usual method of tying off the blood supply and freeing the intestine to be removed from its mesenteric attachment is carried out. The intestine to be removed is crushed at each end with a thin serrated forceps, and a strand of large silkworm gut, plain catgut, or a small flexible wire is thrown around the intestine at the crushed area and threaded in the loop-clamp in such a way that a clamp can be held in each hand of the assistant, and the intestine held in ap-

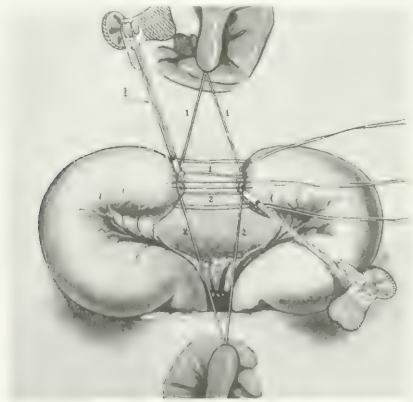

Fig. 3.

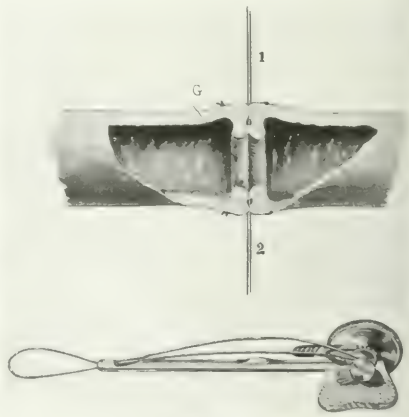

Fig. 5.

position by the instrument, as it were, so the assistant will not be in the way of the operator, and by the aid of the ratchet the gut or wire is drawn taut around the intestine at this area, as shown in Figure 1, *A*. A ligature is tied tight around the intestine about three-quarters of an inch to the inner side of each clamp to hold the contents of the segment to be removed, as shown in Figure 1, *B*. With the cautery the intestine is then severed between each clamp and ligature, which renders each end sterile as shown in Figure 1, *C*. (This can be done with the knife and treated with carbolic acid and alcohol in the absence of the cautery.) The first mattress stitch is then put in at the mesenteric formation of the intestine, care being used to incorporate each fold of the mesentery in this stitch so as to prevent a leak and to insure the blood supply to the walls of the intestine, as shown in Figure 2, *D*. A mattress stitch is then placed on each side of the first stitch, and the assistant holds the two ends in apposition by the handle of the clamp, as shown in Figure 3, *E*, while the traction sutures *1* and *2* in Figure 4 are put in each side of the intestine as shown in Figure 5, *G*.

The anastomosis is finished and care is used to insert the sutures close to the loop-clamp so that too much intestinal wall will not be turned in. Quite often it is necessary to put in a few Lembert sutures to insure perfect coaptation of the intestinal walls. After the sutures have been tied, the silkworm gut loop is cut as shown in Figure 4, *F*, and the strand of silkworm gut pulled out. If plain catgut is used in the loop-clamp it may be cut close and allowed to remain in, as it will fall in the lumen of the intestine after it has been freed. Traction is exerted on traction sutures *1* and *2*, which will pull open the double diaphragm; otherwise it might be held sealed by the action of the cautery. The traction sutures may be pulled out or cut close and Lembert sutures placed over them, as it has been passed through the serous and muscular coats of the intestine between the crushed area and the cauterized end of the intestine.

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A NEW TECHNIQUE FOR POSTERIOR GASTRO ENTEROSTOMY

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DURING the last decade the small forceps formerly used to hold the stomach and jejunum in apposition in performing gastro-enterostomy have been supplanted by various types of clamps which make the operation difficult for those unused to them. It is not my object to enter into a discussion of the advantages of different types of clamps, but to present a modification of the usual technique, which simplifies the operation. I have abandoned the use of clamps, for I believe they are of no real value and that they sometimes traumatize the visceral walls.

In the technique which I have devised two guide sutures are placed 7 centimeters apart to fix the stomach and jejunum (*I*, *II*, Fig. 1). This will permit an opening of approximately 5 centimeters. I first suture the serous surfaces, using a straight needle which is passed from left to right, and then suture the stomach to the mesocolon (Fig. 1). I then remove the guide suture (*II*, Fig. 1) and, with forceps passed underneath the jejunum through the opening in the mesocolon (Fig. 1.), grasp the serous suture and the remaining guide suture (*I*, Fig. 1) and draw them through the opening in the mesocolon. After turning the jejunum to the left side of the patient so that the line of sutures described lies posteriorly, I open the stomach and jejunum, clamp the blood vessels and resect any excess mucous membrane. I

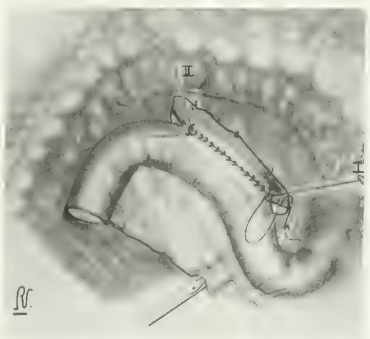

Fig. 1.

Fig. 2.

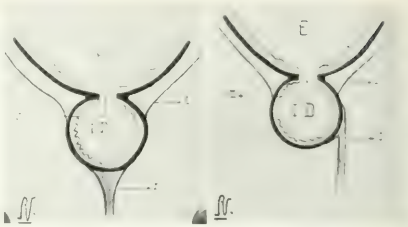

Fig. 3. Fig. 4.

begin the suture of the mucous membrane on the left side, maintaining tension on the layers to be sutured. After completing the suture of the posterior layer of the mucous membrane I begin again at the left and insert the anterior layer of sutures. In completing the anterior layer I bring the inferior angle of the anastomosis into plain sight by exerting tension upon this point. I then complete the serous suture and with a few interrupted sutures close the opening in the mesocolon.

This method makes it possible to keep in plain sight constantly those portions of the bowel which are to be united. Because the opening in the jejunum is made opposite the mesenteric attachment (Fig. 3) and not near it (Fig. 4), as sometimes happens when clamps are used, the blood supply of the bowel is well maintained. Since there are no clamps in the way the surgeon has better access to the margins of the opening in the bowel and stomach, and it is possible to make the opening of the size which he considers advisable.

Technical errors which may arise from the use of clamps are torsion of the fixed gut in its longitudinal axis, improper orientation of the line of anastomosis, interference with the blood supply, and incomplete hæmostasis. As a result there may be dilatation of the stomach, vomiting, hæmatemesis and jejunopeptic ulcers.

The technique which I propose differs from the usual technique in that clamps are not employed, and that after inserting the first line of serous sutures the jejunum is turned from the right to the left side of the patient. I have performed this operation eight times, and am well satisfied with the results obtained.

A NEW METHOD OF MAKING URETEROPYELOGRAMS

BY NATHAN P. SEARS, PH.B., M.D., SYRACUSE, NEW YORK

DURING the past few years the kidney and ureter have been recognized as taking a prominent place among the causes of vague abdominal pain. Many times definite conditions which might have been discovered by careful physical examination and history, and the usual method of cystoscopy, have been overlooked.

However, there is still an appreciable number of patients with vague, persistent abdominal pain, which simulates renal and ureteral colic, for which no apparent cause exists when the patient is examined by our usual methods. Hunner has called attention to stricture as demonstrated by wax bulb method. Kinks and strictures are seen at times by the usual methods of ureteropyelography, but it seems to the writer that ureteropyelograms taken with the ureter in its uninvaded state would give more definite information. P. E. McGowan in the *American Journal of Urology*, vol. iv, discussing paper of Crabtree and Sheddon, states that he is making such study. Goldstein has used fluoroscopy, taking pyelograms with catheter at various levels.

The following technique is simple and has the advantage of filling the ureter from below, without having first disturbed its natural course by passing the catheter, and also prevents the reflux of solution about the catheter.

TECHNIQUE

A wax spindle about 2.5 to 3 millimeters in diameter is placed on the whistle tip catheter about 1 to 1.5 centimeters from the tip. The catheter is threaded back through the cystoscope in the usual way of passing wax tips (described by Harris and also by Hinman). The instrument is then introduced, the catheter with the bulb is passed into the ureter to be studied so that the bladder wall holds the bulb. This permits the tip of the whistle tip catheter to enter the ureter. The other side is catheterized and urine collected from each for study. The patient's shoulders are elevated slightly and a 14 by 17 X-ray plate is placed under the back so that it inclines downward at an angle of about 10 to 15 degrees. The ureter and pelvis are then gently filled in the usual manner.

If the patient is flat on his back the upper ureter does not fill, probably due to the fact that the fluid, after crossing the iliac crest, flows rapidly to the pelvis and produces the pain of distention, prohibiting further injection. The Tren-

Fig. 1. Normal ureter and pelvis, low kidney.

Fig. 2. Constriction of broad ligament portion of ureter due to advanced cervical carcinoma.

Fig. 3. Marked ptosis kidney, numerous kinks in ureter.

delenburg position permits the kidney to fall upward and thus disturbs its casual position and does not give true information. After the picture is taken the catheter may be passed up, or, if the bulb interferes, another catheter passed in place of the opposite one, which can be removed, is passed to drain the fluid. However, the fluid usually flows back more quickly with the catheter low in the ureter than with the older method.

By this technique accurate information regarding stricture or kink can be obtained and obscure causes of pain located.

I will reserve discussion of the interpretation of these findings and their clinical significance for another paper.

FURTHER OBSERVATION OF HEART MASSAGE AS A FINAL RESORT FOR RESUSCITATING HEARTS FAILING UNDER GENERAL ANÆSTHESIA

By T. C. BOST, M.D., Charlotte, North Carolina

THE expression, heart massage, in its surgical meaning implies intermittent compression or kneading of the organ and has for its object the re-establishment of cardiac action which has failed, as during the progress of a surgical operation or while the patient is under the influence of a general anæsthetic.

A word as to the physiology of the heart might not be out of place, and in this connection the question might naturally arise, Why does the heart stop? It is equally pertinent to ask, Why does the heart beat? The prevailing opinion leans toward the myogenic theory, which holds contractility to be an inherent function of the cardiac muscle and the one fact that stands out pre-eminently is that the greatest rhythmic power resides in the basal portion of the heart, that is, in what corresponds in the more primitive hearts to the sinus venosus.

From a surgical standpoint, the failure of the heart in the majority of instances may be accounted for by reflex vagus inhibition and the action of the toxines from the anæsthetic and other sources directly upon the heart muscle.

Heart massage according to Keen, D'Halluin and, recently, Gunn favors resuscitation by: (a) depletion—emptying mechanically the cardiac chambers; (b) by a mechanical irritant, stimulating the reserve energy of the cardiac muscle; (c) creating an artificial circulation which keeps up the nutrition of the myocardium, and supplies fresh blood to the brain. Physiologists have put great emphasis on the value of artificial circulation. Of these, may be mentioned Gunn, who injected a dye in a peripheral vein and detected it in a peripheral artery after a few compressions of an arrested heart, thus establishing its value. Zezas attributes to the artificial circulation the success of heart massage.

Massage, as a practical means of treatment in cases of failure of the pulse and respiration, especially those occurring during general anæsthesia, is based not only upon a series of physiological experiments, but upon clinical evidence as well.

The experiments began with the work of Schiff in 1874. He showed by chloroforming a number of dogs until the heart ceased to beat that artificial respiration and stimulation by electricity were of no avail, but that massage directly applied restored cardiac action after an interval of 11½ minutes. Tuffier and Hallion communicated a similar series confirming this work. In 1900 Prus published the results of experiments performed by him on 100 dogs, killed by electricity, by suffocation, and by administration of chloroform. Heart massage and artificial respiration were started in periods varying from 55 seconds to 1 hour. Of those in which the heart was arrested by electricity, massage was successful in 14 per cent; while in the others, over 75 per cent were resuscitated. Prus concludes that life can be induced to return even after the heart has ceased to beat for 1 hour. Provost and Balleti from results in animal experimentation concluded that fibrillary twitchings of the heart muscle were the greatest bar to successful massage, and showed that the longer the time which elapsed between the stoppage of the heart and the beginning of the massage, the greater was the probability of these twitchings appearing. White, in 1900, was unable to restore either respiration or circulation by artificial respiration alone, even by inflating the lungs with a bellows

after the heart had ceased. The work of Crile and Dolley pointed out the fact that artificial respiration and cardiac massage should be carried out simultaneously.

This extraordinary power of the heart to regain its function after apparent death under certain physiological conditions is well known to the laboratory worker in the field of heart massage.

The first report of massage of the human heart was made in 1898 and the first successful case was as late as 1902 by Starling and Lane, so that as a therapeutic measure heart massage may be considered of fairly recent application.

Green reviewed the literature in 1906 and gave an abstract of 40 published cases. White collected an additional 10 in 1909, making a total of 50 cases.

I have searched the literature very carefully and have collected 25 more cases, making a total of 75, including the 2 here cited.

The methods employed have undergone considerable evolution:

1. *The thoracic route.* A flap of the thoracic wall over the cardiac area is cut and turned back. This procedure is necessarily forcible and must accentuate shock as many intercostal vessels and nerves are involved. Pneumothorax, too, has occurred in several of the published cases, and it is not surprising that the method has been abandoned, except in operations on the heart and lungs, in which a breach in the thoracic wall has already been made.

2. *The abdominal subdiaphragmatic route.* A median line epigastric incision is made and the right hand introduced below the diaphragm and the left placed over the cardiac area, interposing the heart between. This method has been most generally used, as it was a most natural thought when the heart action was arrested during the progress of a laparotomy, and when promptly done the conditions were favorable for resuscitation. It is the facility and the promptitude that secure success. It has been demonstrated, in a child, whose thorax is small and tissues elastic, that subdiaphragmatic compression of the heart is possible though difficult, but in the adult it would rarely be effective, in the obstinate case, as only the apex can be reached, making it impossible to empty the distended cardiac chambers or massage the base of the heart where the greatest rhythmic power resides. Thus the need for the transdiaphragmatic to reach the base, when this method fails.

3. *The abdominal transdiaphragmatic route.* In this method a median line epigastric incision is also made and the diaphragm is incised approximately anteroposterior, splitting the muscle fibers and gaining direct access to the pericardium. Contractions of the heart have been thus produced in practically all the cases however late applied; as, for example, Green's case, in which an hour after apparent death he incised the diaphragm and was able to produce a few contractions. While this method affords direct cardiac massage and is superior to the thoracic, yet it is objectionable in that it is a very difficult procedure. The stomach and left lobe of the liver handicap the incision of the diaphragm. There is also some risk of injury to the musculophrenic artery which may cause concealed hæmorrhage. Suturing of the opening in the pericardium and diaphragm is as difficult as it is necessary. Hence the advantage of the author's technique as worked out on a cadaver and applied in two cases.

4. *Author's method.* An abdominal incision is made in the median line extending well up to the ensiform cartilage. The left costal cartilages are well retracted, bringing the anterior diaphragmatic insertion well into view. A 2-inch incision beginning 1 inch to the left of the median line, carried outward behind the costal margin, cuts the fibers of the diaphragm near their insertion. The opening is rapidly dilated with two or three fingers of the right hand, so that the hand can be passed into the thoracic cavity, and the base of the heart effectively massaged. No vessels are injured in this incision, as the superior epigastric artery is to the inner side and the musculophrenic branch enters the diaphragm deeper than the incision. The liver and stomach, even if prominent, offer no obstruction to this route; nor is the pericardium in risk of being opened. During the massage the parts fit snugly around the wrist of the operator so that air is not sucked in, and there is no tendency to collapse of the lungs. The incision is easily closed and made airtight with a continuous catgut suture.

As to the technique for doing massage, it is pretty well agreed that this should be gentle compression of the heart at about half its normal rate to allow the heart to fill well, also this is in keeping with the rate at which the heart will start, which has been shown to be always slow. When the heart starts, massage should be stopped to allow it to regain tone and establish itself of its own accord, or at most only compressing the heart occasionally.

Mrs. H., age 38, mother of one child age 6, entered Presbyterian Hospital May 10, 1921, complaining of pain in lower abdomen of 5 years' duration, also irregular menstrual bleeding for past year. Examination revealed

slight local tenderness in lower abdomen and on pelvic examination uterus was irregular, about three times the normal size, and a small movable mass could be palpated on the right side. Physical examination of lungs and heart negative. Urinalysis negative. Blood: white blood cells, 8,500; red blood cells, 4,500,000; hæmoglobin, 85 per cent. Diagnosis: fibroid uterus, with a probable right ovarian cyst. Patient appeared otherwise normal and as a good surgical risk.

Operation May 11, 1921. Usual preliminary preparations with morphine ¼ grain and atropine 1/150 grain. Ether was administered and well taken. Hysterectomy was done for multiple fibroid uterus, also a right ovarian cyst and appendix were removed. The operation was finished and the peritoneum closed in 35 minutes, and at this stage head of table was elevated from Trendelenburg position and immediately patient ceased to breathe. Head of table was at once lowered and artificial respiration instituted. No pulsation could be felt, pupils dilated and insensitive. Atropine 1/100 grain and camphor in oil 3 grains were given. Drs. Ranson and Petteway could detect no heart sounds by auscultation. Several sharp percussion blows were made over cardiac area. After a lapse of 3 minutes the peritoneal sutures were removed and subdiaphragmatic massage done which caused a slight improvement in patient's color, but no heart beat or attempts at respiration. Extremities were bandaged and artificial respiration continued the whole time. Patient's expression changed to a waxy pallor and it was evident to all doctors and nurses present that patient's condition was hopeless. After a lapse of 6 minutes I proceeded to do direct heart massage by making an epigastric incision and incising the diaphragm, introduced my hand in the chest, and found the heart arrested in systole. I began gently squeezing the heart at about 25 or 30 times per minute. In a few seconds a reddish hue was observed in patient's color and in about one-half minute a slight muscular twitch was felt and then the heart began beating very feebly and slowly, but in a few seconds a radial pulse could be felt, after cardiac action had been suspended for approximately 7 minutes. Five minutes later spontaneous respiration began, not more than 3 or 4 per minute, but gradually improved. Oxygen and saline given. Incision closed. Patient returned to room in apparently good condition. Respiratory rate 20, pulse 100 with good volume. In about one-half hour patient began to react to a semiconscious condition, opened eyes, and attempted to speak, and moved about in bed. Several hours later pulse began to increase in rate and muscular twitchings developed in face and extremities; also pulse rate increased. Morphine and saline again given; also digifolin, but heart rate continued to increase, and it was soon evident that the patient was gradually losing and died, next morning, about 14 hours from time of resuscitation.

No autopsy was done, but in all probability nothing could have been found to account for this primary failure. The ultimate failure, after resuscitation, was in all probability due to the irreparable damage to the cortical cells during the suspended circulation.

This is a typical example of the cases, apparently good surgical risks, that suddenly pass out under general anæsthesia with no apparent reason.

This is my second case. The first was reported in the London *Lancet*, 1918.

Briefly, Pvt. B. had infected wounds which resulted in metastatic infection. He was given an anæsthetic and just as an incision was about to be made respiration and pulse ceased. The ordinary methods of resuscitation were employed for 10 minutes. Following this subdiaphragmatic massage was done for an additional 10 minutes, with no response. The diaphragm was finally incised and direct massage done which only required ten or twelve gentle squeezes to start heart action, after it had been suspended for approximately 25 minutes. The patient lived 77 hours and at autopsy metastatic sepsis was found to account for the death.

The present available statistics of 75 cases subjected to heart massage, showed that 16, or 21⅓ per cent were successful, making a complete recovery; 23, or 30⅔ per cent were partially successful in that the heart and respiration were revived, but the patients died in from one-half hour to 2 or 3 days. Death in several instances was probably due to a toxæmia which was in no way connected with the resuscitation, as, for example, my first case; nevertheless such cases have been put into the group of partial successes.

Gunn concludes from his experiments that the difficulty is not so much in starting the heart beating, but in starting it beating sufficiently soon that the cortical cells in the meantime have not been rendered incapable of recovery by stoppage of the circulation. To substantiate this, in the last reported 10 cases cardiac action was established in all, but only two made complete recovery. It is also concluded by Gunn that the time limit for revival of the cortical cells can be calculated not as from the start of spontaneous heart beats, but as from the time of beginning massage, pointing out the value of artificial circulation which is of fundamental importance and puts a more hopeful outlook on the whole question of resuscitation.

However, from these figures we can rightly conclude that the results in the main have been favorable in that more than one-fifth of the cases have been saved, and more than half of the total number have been resuscitated in a measure. The question now arises: How can we adjust heart massage in proper accord with its surgical bearings and save more of these cases? In studying the reports the successful cases have been most naturally those that were subjected to massage early in the syncope, and the possibility of resuscitation bears a somewhat definite relation to the time that elapses between the cessation and the massage. How long one is justified in waiting while carrying out the ordinary means of resuscitation before resorting to massage, may be judged in a measure from the fact that there have been but two recoveries when the syncope has lasted more than 10 minutes, and the largest measure of success has been when the interval did not exceed 5 minutes. Mollison's case made a good recovery after an

interval of 13 minutes, but showed profound mental symptoms for several weeks. Mollison and others have pointed out that the anæmia of the brain after a questionable interval produces irreparable damage to the delicate brain cells and other vital organs.

Fisher and Gunn advise boldness of procedure if heart has been stopped 3 or 4 minutes, stating there can be no further risk. Russell judges from experiments, clinical experience and reports of recoveries after massage that "we are probably safe in assuming that about 5 minutes' loss of circulation is the outside limit that the human brain can withstand and recover completely."

Norbury has recently advocated massage after giving other methods a trial of only 2 minutes, and concludes that the fact that artificial respiration can be of no use in the absence of circulation is often overlooked.

My conclusions from clinical experience are in entire accord with those reached by Fisher, Gunn, and Russell in research laboratories, that is, massage should be resorted to in any case in 4 or 5 minutes, and if the abdomen be already open, massage should be commenced at once. A lapse of a longer interval should not bar this procedure. When the operation is decided upon the subdiaphragmatic method should be first done, it being the simplest, but in obstinate cases, especially in adults, where satisfactory compression of the heart below the diaphragm is impossible, as it was in my cases, this method should be dispensed with in 2 or 3 minutes in favor of the transdiaphragmatic method.

Another point of interest in this connection is the relatively small number of cases that have had the advantage of heart massage, as compared with the number that probably goes into the thousands, of so-called, "died on the table or anæsthetic death" that were never given a chance. Nearly every surgeon of broad experience has been confronted with this condition and, I might add, almost every interne or resident physician has seen these cases that "went bad under the anæsthetic," were given prolonged artificial respiration, pulmotors employed in many cases, and stimulation of various kinds and other methods of resuscitation carried out for a variable length of time, yet they fail to re-establish the circulation and the case was eventually taken to the morgue.

CONCLUSIONS

1. Heart massage is an established method for re-establishing cardiac action which has suddenly failed under general anæsthesia, and it is based both on physiological experiments and on clinical work.

2. The possibility of resuscitation bears a somewhat definite relation to the time that elapses between the cessation of the heart and the massage, and the shorter the interval the more certain is the response.

3. If the abdomen be already open, massage should be instituted at once. Otherwise not more than 4 or 5 minutes should be consumed in attempting resuscitation by ordinary methods. If, for unavoidable reasons, more than 4 or 5 minutes have elapsed, the procedure should not be barred.

4. Subdiaphragmatic massage may suffice, especially in children and if promptly undertaken, but if only the apex is reached and the heart remains unresponsive after 2 or 3 minutes, it should be dispensed with in favor of the transdiaphragmatic method.

5. This new technique offers a simpler method of approach and is believed to be a decided improvement upon all other methods of doing direct heart massage, as it enables the operator to grasp the heart, involves less risk of hæmorrhage, trauma, lung collapse, and shock, and the incision can be more quickly and satisfactorily closed.

6. No surgeon, even if relatively unskilled, should be content to abandon a case without giving his patient the benefit of direct cardiac massage.

7. There is a great need for a more general use of heart massage as it will serve as a final trump card for reviving many who would otherwise perish.

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A NEW PROCEDURE IN THE TREATMENT OF ECLAMPSIA

By H. J. DAVIDSON, M.D., F.A.C.S., Seattle, Washington

MAY, 1921 through this journal, I presented a preliminary statement on "A New Procedure in the Treatment of Eclampsia." In presenting the subject again, I shall make reference to additional phases of the problem sufficient to convey a rational understanding of the justification for the procedure both from the standpoint of the condition existing in the eclamptic woman and for explanation of the results I claim.

The death rate from eclampsia has not been affected materially by changes in treatment in the last one hundred years. As authority for that statement you are referred to the third edition of DeLee's *Principles and Practice of Obstetrics*, published in 1918, and Williams' *Obstetrics*, published in 1920.

That the statements in my paper may be properly correlated, I choose in the very beginning to say that my message is to urge the introduction of water in large quantities through the tube into the stomach or into the duodenum.

In eclampsia several clinical features stand out pre-eminently: the patient is unconscious or at least only semiconscious, the convulsions occurring at intervals are alarming to the physician and family alike, death apparently imminent in each one, the urine is suppressed or greatly reduced and carries albumin, and the patient is usually œdematous. The emergency may occur before, during, or after parturition.

The accepted routine treatment with which all are familiar is resorted to with sad realization of its inefficacy. In cases of recovery we thank good fortune 75 per cent and our professional efforts 25 per cent.

The term cardiorenal conveys to the mind a definite conception of related symptoms and pathology. In considering eclampsia, I propose the term hepatorenal, and believe that the term deserves permanence in that it conveys a comprehensive mental impression of the eclamptic complex. Furthermore I believe it to be a toxic hepatorenal block.

The characteristic changes induced in the liver, similar to those caused by eliminating portal circulation from the liver, together with similarity of symptomatology, point very strikingly to profound hepatic disturbance, recognition of which in association with accepted ideas referable to the kidney seem to justify the term toxic hepatorenal block. The toxic agent is probably more unlike that precipitating uræmia than is commonly held.

Total extirpation of both kidneys fails to produce a syndrome like that of eclampsia, death supervening with symptoms of drowsiness and lassitude without cerebral excitation or convulsions, after a lapse of time varying up to 22 days. Eck fistula, the anastamosis of the portal vein with the vena cava, depriving the liver of the portal circulation, on the other hand, not only causes symptoms simulating eclampsia, but produces similar histological hepatic changes. In the newborn, persistence of ductus venosus arantii produces like results.

That the condition is of the nature of a toxic block is strongly suggested by the immediate return of adequate function following therapy. The sequence following the administration of diphtheria antitoxin is no more striking nor more certain. The toxic agent seems to be from disturbed metabolism, however, rather than from viable infectious agent.

The nature of the exciting toxic agent, factors contributing to its production, site of elaboration, exact manner of its action, phenomenon of detoxication and elimination are all undetermined, in spite of vast research.

Discussion of the possibilities as to primacy in the liver or the kidney, or elsewhere in the body with secondary effect upon them is not within the scope of the title, nor necessary for comprehension of my hypothesis regarding treatment.

Pertinent to the possible nature of the toxic agent and the bio-chemistry of the liver and kidney under its influence, I will present certain facts for consideration.

The eclamptic sequence has features explainable on the hypothesis of colloidal block, either a colloidal substance of remote origin causing cessation of hepatic and renal function with cell necrosis in the liver, or a toxic colloidal block elaborated within the hepatic or renal cells themselves, consequent cumulative cortical stimulation eventuating in convulsions.

A sufficient amount of crystaloid or electrolyte delivered at the critical point will break the colloidal block. Furthermore it is an established fact that a given amount of electrolyte added slowly is less potent than if added in bulk or rapidly.

Procedures in previously accepted treatment of eclampsia are notorious in that electrolyte is delivered slowly and in dilution.

Water given by hypodermoclysis is added to the stagnant supertoxic fluids already in the tissues and tissue spaces. It is slowly absorbed and reaches the liver and kidneys fractionally and greatly attenuated. Water given by rectum is slowly absorbed, if retained, enters the hæmorrhoidal and inferior mesenteric circulation from viscera with poor absorption facilities and passes only in part by way of the portal. Water given by intravenous administration is disseminated throughout the systemic circulation and finally reaches the portal circulation greatly diluted and in fractional parts after having passed through two sets of capillaries, those of the lungs and those of the splanchnic area. Water given by way of the stomach is absorbed directly into the portal system and conveyed in highest concentration to the liver, delivering the greatest amount of electrolyte in highest concentration in minimum time. It is a significant fact that in health water given by mouth is excreted by the kidneys more promptly than if given by any of the other three ways. In further study of the biochemistry of water, it may be demonstrated that it is not easily excretable by the kidney until it has been acted upon by the liver via the portal circulation. A surprisingly large quantity will be assimilated in a brief time. That most water taken by mouth is absorbed into the portal circulation is evident from the fact that no matter how much is ingested, watery stools do not ensue.

The high degree of flatulence, the unconscious state of the patient and the ineffectiveness of even drastic cathartics, have seemed to contraindicate therapeutic gavage. The apparent similarity between postoperative ileus with gastric distention, and postpartum flatulency in eclampsia has no doubt contributed to the continuance of the assumption.

Entirely divergent factors contribute to the two conditions. In the former the abdomen has been opened and the contents have been subjected to exposure to air, to handling, to drying, to cooling, to the irritation of gauze, and often to operative procedures. In the latter sudden remarkable reduction of intra-abdominal pressure is probably a contributing factor. Peristalsis and absorption are not arrested. In the former, administration of fluids and cathartics are dangerous. In the latter the stomach will not only retain a large quantity of water but will pass it on to the intestines where absorption promptly follows. The mere volume and weight of the fluid introduced possibly contributes to stimulate normal peristaltic function, or as demonstrated by Wheelon and Thomas, the pylorus remains wide open, and the water pours rapidly out of the stomach.

Certainty that the tube is in the stomach and not in the trachea and watchfulness for onset of retching and regurgitation are necessary but are not of sufficient seriousness to condemn a method that promises to reduce mortality from over 20 per cent to an approximation of zero.

I believe the obstipation of eclampsia is due to lack of water content in the alimentary tract, unless that too is temporarily in a state of toxic block. With gavage carrying a moderate amount of saline laxative, copious, free evacuation will occur without the use of drastic cathartics.

The hepatorenal block broken, copious secretion of urine follows, perspiration pours from the skin, the convulsions cease, the mental state clears, and in a short time the albumin markedly diminishes or disappears from the urine.

Either the precursors of the toxins or the toxins themselves which precipitate the block seem to continue to be elaborated for some time after the block is broken. Unless energetic treatment is continued for a considerable time after cessation of convulsions, return of consciousness and re-establishment of renal function, the patient may promptly return to her previous desperate state.

My routine treatment in postpartum eclampsia consists in first giving a large dose of morphia hypodermatically, 0.5 to 1 grain, repeating as indicated. Every 4 hours 1 to 1.5 liters of water is put into the stomach through the tube, the larger quantity unless signs of retching supervene, in which case the tube is quickly withdrawn. I have never had regurgitation or vomiting, and have never had to stop short of a liter. In some instances the quantity has approached 2 liters. In a total of over seventy gavages, I have never recovered a drop of water introduced 4 hours previously. One to one and a half ounces of Epsom salts is given twice in the 24 hours and 20 grains of potassium acetate and citrate or some alkaline diuretic with each gavage. Excessive bedclothing, artificial heat, hot packs and bleeding are all discarded. I secure perspiration more promptly and far more copiously than by the old procedures.

The simplicity of the procedure makes it possible to render efficient treatment in the poorest home. The flatulence is combated by means of esserin, pituitrin, hot stupes and enemata. Car-

diac stimulation is used if indicated and spinal puncture if vision is affected and the eyegrounds show œdema of the disk. Even if it has to be administered by the physician himself, five or six short visits a day will suffice, leaving much time for other work.

It must be remembered that the babe is toxic and may die unless it too is given water in as large quantity as possible.

In prepartum eclamptic convulsions, I think it advisable to use the duodenal tube, as the stomach probably would not retain a liter and a half of water at one time, while it is very easy to introduce that amount into the duodenum in a very short time. The tube may be left *in situ* provided the patient is conscious or attendants can prevent withdrawal.

Personally I have had no experience with the duodenal tube, as all the prepartum cases I have had were near enough term that the child was viable. The uterus was emptied immediately, one vaginal section for an eight month child, two eight months' cæsareans, one being twins and three cæsareans at term. One case was during labor with complete dilatation, so forceps were immediately applied. In all cases the postpartum routine was used without the least difficulty.

In the series of twelve cases no maternal death occurred. One child was lost, I believe due to our negligence. Following a cæsarean in a case near term we were so intent on the mother that we failed to give the nurses explicit instructions as to the care of the babe. When it was 24 hours old, it had one convulsion and died.

SUMMARY

In the eclamptic woman far more water can be introduced by gavage than by any other route or combination of routes.

Water is introduced through its natural portal of entry insuring more rapid absorption and elimination by the kidney.

The water is nearly all delivered quickly and directly to the liver through the portal circulation.

If eclampsia is a toxic hepatorenal block a maximum of electrolyte is delivered at the critical point in minimum time insuring the promptest possible break of the block.

The procedure simplifies the treatment of eclampsia making efficient treatment possible in the home.

In my hands the procedure seems to have reduced mortality in excess of any contribution during the last century.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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FEBRUARY, 1923

THE SCOPE AND TEACHING OF PLASTIC SURGERY

As considerable misapprehension exists among both surgeons and physicians as to the scope of plastic surgery and the training necessary to do this work properly, it seems advisable to make these points clear. Plastic surgery is that branch of general surgery which deals with the repair of defects caused by disease, trauma, burns, and necessarily mutilating operations, and with the correction of certain congenital malformations. Its field extends from the top of the head to the bottom of the foot, and the lesions dealt with, in most instances, involve the skin and adjacent soft parts, and often the framework (especially of the face) supporting these parts.

Plastic surgery of the trunk and extremeties, a most important part of the subject, was entirely ignored by the military medical services during the war (1914–1918), and they showed a profound lack of knowledge of the scope of the subject by restricting the field to maxillofacial reconstruction. This has led many, who previously knew nothing of plastic surgery, to the conclusion that facial reconstruction is all of plastic surgery, when as a matter of fact it is only one part. It is most important, if its possibilities are to be understood, that the subject be visualized as a whole, and not be thought of from the viewpoint of any of its subdivisions.

For years it had been urged by those familiar with the intricacies of plastic surgery that it should be separated from the general surgical tree and that special training should be given in preparation for this difficult work.

Little heed was taken of this advice, and in consequence when wounded men began to come in who required facial reconstruction and were sent to the "Head Section," few knew how to take care of them. It was then realized that special training was essential in order to do this work properly. Experience elsewhere has shown that this also applies in an equal degree to the plastic problems of the trunk and extremities, which differ materially from those of the face.

In the wards of every general hospital, on every surgical service, we constantly find cases which should be on the plastic service, if one existed, and which are simply being "carried along." This condition cannot continue, and we may confidently expect within the next few years, that there will be a plastic service in every large hospital under the charge of a surgeon who is prepared to deal with plastic problems of the entire body. Investigation shows that the teaching of this important subject has been sadly neglected, and as yet there is no department equipped for the proper instruction of plastic surgery, as a whole, in any American or foreign university.

The following is suggested as a general plan for the teaching of plastic surgery. The first requirement is that a competent plastic surgeon should be in charge of the plastic service and of the teaching of the subject. The term *general plastic surgeon* is used to distinguish the surgeons who have given special attention to plastic problems of the entire body, from those who have confined their work to facial reconstruction of one sort or another. As many ward beds as are needed should be assigned to the plastic service, and also as many house-officers as are required. In short, all necessary equipment should be supplied for the care of patients and for the teaching of the subject as a whole. During the third year a short series of lectures should be given which should cover, in a general way, the entire field. Numerous lantern slides should be used to illustrate the plastic problems and the procedures necessary to solve them. This will show the students the scope of the subject and give them an opportunity of knowing what can be done in this field.

During the fourth year, plastic surgery should be an elective course for those interested, and the fundamentals should be taken up systematically by means of practical work in the out-patient plastic clinic, and by conferences and demonstrations in the operating room and in the wards. As "an adequate practical training in the principles and practice of general surgery" is necessary as a preparation for any real surgical specialty, it follows that the final instruction in plastic surgery should be given to the post-graduate student. These men should be carefully selected, as it is impossible to make a plastic surgeon out of a man who has no aptitude for it. The post-graduate student should have the opportunity of working in the plastic clinic of the out-patient department, the privilege of the operative clinic with an opportunity of assisting and receiving personal instruction in operative technique, and eventually be allowed to perform operations under the direction of the chief. He should have the privilege of following the cases in the wards and of studying post-operative treatment, and the chance to do experimental and clinical research on plastic problems. He should be able to study in the pathological laboratory the tissues removed at operations.

Men of special ability should be taken into the house on the plastic service, and given every opportunity. The course should be at least one year, preferably two. As soon as adequate courses are offered, there will be little difficulty in attracting suitable men to this fascinating branch of surgery, in which is found an infinite number of difficult problems, the solution of which calls for the keenest judgment and the highest type of surgical skill. JOHN STAIGE DAVIS.

END-RESULTS IN ULCER OF THE STOMACH AND DUODENUM

ONE of the subjects appointed for discussion at the 1922 meeting of the American Surgical Association was: "End-Results Following Surgical Treatment of Ulcer of the Stomach and Duodenum." Comprehensive reports were made from the Massachusetts General Hospital in Boston, the Roosevelt and the New York hospitals in New York, and the Lankenau Hospital in Philadelphia. In the Massachusetts General Hospital cases of ulcer are first studied medically with careful investigation by the X-ray. They are then studied from a gastro-enterologic standpoint and are finally referred for operation. A collaborated investigation of these cases by all the departments revealed that about 95 per cent of duodenal ulcers and more than 90 per cent of gastric ulcers are

cured by operation. These results are similar to those obtained in the other hospitals represented. In the discussion that followed, views were freely exchanged with more or less clearing of the mental fog which obscures this subject.

A review of the cases of ulcer of the stomach and duodenum in our Clinic shows that less than 5 per cent of patients operated on for duodenal ulcer, and less than 10 per cent of those operated on for gastric ulcer fail to obtain satisfactory relief. Our investigations have brought out certain extremely important points with regard to the causes of failure to relieve such patients by surgical measures. The unsatisfactory cases may be divided into two groups:

Group 1. Cases in which failure is the result of faulty surgical methods; (a) placing the opening too far to the left on the body of the stomach so that the pyloric end does not drain well; (b) failure to bring the gastro-enterostomy to the bottom of the stomach, as pointed out by Ochsner; (c) in performing posterior gastro-enterostomy failure to make the opening in the transverse mesocolon sufficiently large, and to suture it firmly to the posterior wall of the stomach, so that subsequently the mesocolon becomes detached from the stomach, drops down over the two limbs of the jejunum at the gastro-enterostomy, causing angulation with insufficient drainage or, at intervals, chronic bile regurgitation; and (d) in adjusting the jejunum to the posterior wall of the stomach too short or too long, without regard to the size or the situation of the stomach.

Gastrojejunal ulcer occurs in 1 or 2 per cent of cases following gastro-enterostomy. In such cases the gastro-enterostomy should be cut off and the gastric and jejunal openings closed. If the ulcer is duodenal, a pyloroplasty should be made after the method of Finney, and if it is gastric, failure of the first operation to give relief usually indicates partial gastrectomy with removal of the entire ulcer-bearing area, as advised by Rodman many years ago.

Group 2. In about one-half the cases of unsatisfactory results the failure is due to faulty dietetics following operation, such as delay beyond the usual time of eating, overloading the stomach, and general faulty subsequent management. Such patients are cured very quickly by competent internists.

The large majority of cases of peptic ulcer seen early are amenable to medical treatment. Only the chronic intractable cases, or the acute cases giving rise to hæmorrhage or localized peritonitis, with signs of perforation are considered for operation. But it should be remembered that the greater number of patients with chronic ulcer are working and have neither the time, nor the money, for prolonged medical treatment. I have not seen a better summing up of the present day indications for surgical treatment than that of Bennett, physician to the Middlesex Hospital in London. He believes that prompt surgical treatment should be given in: (a) all cases with chronic pyloric obstruction; (b) all cases which have relapsed after one course of thorough medical treatment; (c) all cases with a history extending over many years; (d) all cases with large ulcers adherent to surrounding structures; (e) practically all cases in which a test meal is retained in the stomach for more than 6 hours; and (f) all cases whose economic position makes prolonged medical treatment impossible. Bennett says further: "It is surprising how large is the class of patients who must be placed in the last group," and finally concludes: "There can be no escape from the conclusion that the medical treatment of gastric ulcer is a difficult and protracted procedure." William J. Mayo.

MASTER SURGEONS OF AMERICA

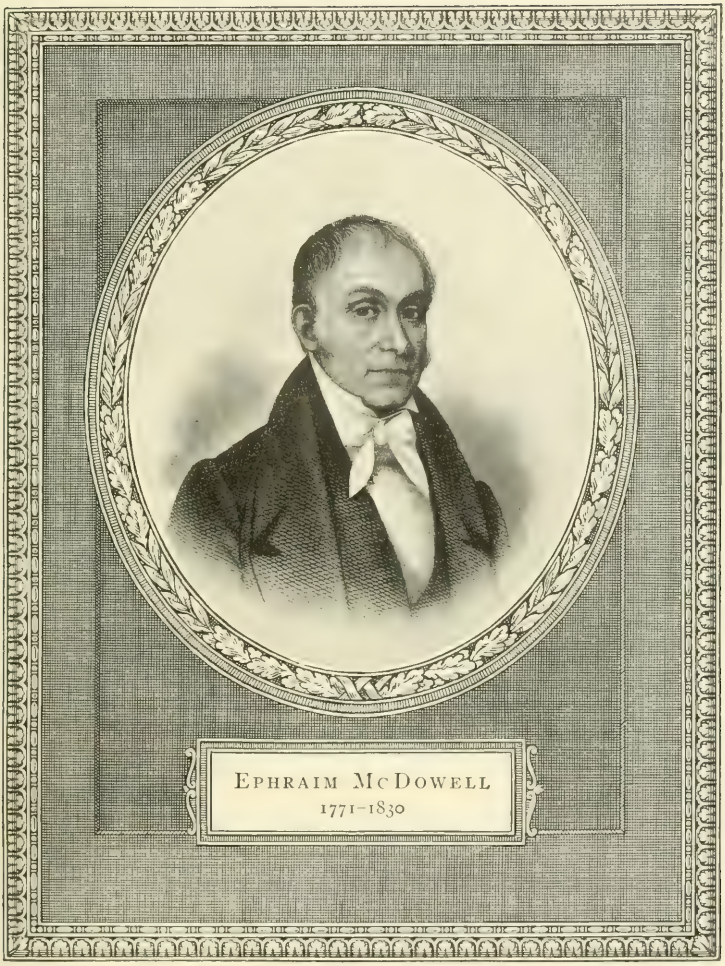
EPHRAIM McDOWELL

IT is difficult for the modern surgeon, endowed with the accumulated resources of science, to realize how comparatively recent are the epoch-making discoveries of anæsthesia (1846) and antisepsis (1875–1880). Ephraim McDowell, the subject of this brief sketch died in 1830, seventeen years prior to the discovery of anæsthesia. These historic data are essential to an appreciation of the magnitude of his undertaking and the difficulties attending its accomplishment. He founded abdominal surgery.

Ephraim McDowell was born in Rockbridge County, Virginia, in 1771. His father, Samuel McDowell, and his mother, Sarah McClung McDowell, were members of Scotch families, who, on account of religious persecution, took refuge in the north of Ireland and later emigrated to the valley of Virginia. In 1783 his father removed to Kentucky which was then a part of Virginia. Having received appointment as Judge of the District Court of Kentucky, he removed his family to Danville, which thence became their permanent home.

Ephraim McDowell received his early education at a classical seminary at Georgetown, Kentucky. He then went to Staunton, Virginia, and became an office pupil of Dr. Humphreys, a noted medical practitioner of that place. Dr. Humphreys was a graduate of the University of Edinburgh, and it was through his influence that McDowell in 1793 went to that famous university to pursue his medical course. He remained in Edinburgh two years, returning to Danville in 1795 to enter upon the practice of his profession. Bearing in mind the limited requirements in medical education of the period, and that Edinburgh at that time was pre-eminent throughout the world as a center of medical culture, it is apparent that, both in preparatory study and medical instruction, McDowell enjoyed advantages unsurpassed by any of his professional contemporaries in America.

While attending the medical course at the University of Edinburgh, he was a member of the private class of John Bell, at that time an extramural teacher of surgery. That he was most profoundly impressed by the teaching of this able and eloquent Scotch surgeon, and that he received from him inspirations that influenced him throughout his career, cannot be doubted. For some reason, most probably technical, he did not receive a medical degree in Edinburgh. In



EPHRAIM McDOWELL
1771–1830

1807 the Medical Society of Philadelphia awarded him its diploma, and in 1823 the University of Maryland conferred upon him the honorary degree of M.D.

Gifted in many ways, with superior education, and coming from the most famous medical school in the world, McDowell soon assumed the first position as physician and surgeon in his locality. Within a few years his reputation extended throughout the adjoining states, and for a quarter of a century he was undisputedly the most eminent surgeon west of the Alleghanies. He made long journeys on horseback to visit and operate upon patients who were unable to visit him at home. Although doing general practice, his predilections were for surgery. He did all the surgical operations then practiced. He was especially successful in lithotomy, operated many times for strangulated hernia, and did various amputations and other operations, including tracheotomy.

In 1809, fourteen years after he began practice, his great opportunity came. He was called to see Mrs. Jane Todd Crawford, 60 miles distant from Danville, who was supposed to be pregnant, and to have gone beyond her term, with serious complications. He found the case to be one of ovarian tumor; explained the hopeless character of the disease; expressed his conviction that it was feasible to remove the tumor by operation: frankly acknowledging that it would be an experiment, since it had never been done. He inspired the confidence of his heroic patient, who accepted his proffered aid, and made the journey to Danville on horseback soon afterward. The operation was successfully performed and followed by prompt recovery.

It is known that McDowell had an excellent library for that time, and devoted much of his leisure time to his books; but like many able men of our own time, he was absorbed in practice, and literary work of every kind, especially writing, was burdensome to him. Much of his time was taken up with long journeys on horseback; he was without the stimulus of the daily mail and numerous medical journals, and no medical society existed in his section of the country. Some years elapsed after his first ovariotomy before he made a report for publication, during which time he had operated in two additional cases, both followed by recovery. The title of his paper is "Three Cases of Extirpation of Diseased Ovaries," and his description of the symptoms and operation is concise and clear, but without any detailed account of the pathology and progress after operation. That he was inspired by the teachings of his revered master, Mr. John Bell, of Edinburgh, to his great achievement may be reasonably assumed from the fact that he sent his report to him. This report failed to reach Mr. Bell, and after a time McDowell prepared a copy of his report and sent it to the *Eclectic Repertory and Analytical Review*, in Philadelphia, where it appeared in the October issue, 1816. The brevity and omission of many essential details, which characterized his report, exposed McDowell to criticism, much of which was sarcastic and incredulous. The learned editor of the London *Medico-*

Chirurgical Review expressed outright his disbelief of his statements. A few years later when the accuracy of McDowell's report had been verified and confirmed by the report of additional cases, the editor acknowledged his error and apologized for the injustice of his criticism.

In October, 1810, three years subsequent to his first publication, he reported in the same journal two additional cases. A fair estimate of his surgical ideals can be formed from a paragraph in this report, in which, replying to some criticisms upon his first report, he says: "I thought my statement sufficiently explicit to warrant any surgeon's performing the operation when necessary without hazarding the odium of making an experiment: and I think my description of the mode of operating, and of the anatomy of the parts concerned, clear enough to enable any good anatomist, possessing the judgment requisite for a surgeon, to operate with safety. I hope no operator of any other description may ever attempt it. It is my most ardent wish that this operation may remain to the mechanical surgeon forever incomprehensible."

From the best information available it appears that McDowell performed the operation in thirteen cases with eight recoveries.

McDowell was a man of impressive personality. He was nearly 6 feet tall, of athletic build, and while a student in Edinburgh was noted as a foot-racer. He was courteous and dignified in manner, amiable and cheerful, kind-hearted and charitable. His habits were exemplary, and as a citizen he was helpful in all movements for community welfare. In education he was especially interested, being one of the founders and a member of the first board of trustees of Centre College at Danville, Kentucky's most famous institution of learning. He married a daughter of Kentucky's first Governor, Isaac Shelby, a great statesman and soldier. To them were born five children, three of whom survived their father. He died of an acute illness in his fifty-ninth year.

None of the great pathfinders in American medicine and surgery has been so honored by his successors as has the subject of this sketch. In 1852 Professor Samuel D. Gross, then a resident of Louisville, sought out by correspondence and personal interview the associates, relatives, and former patients of McDowell, gathered together his reports of his operations, and wrote a biography marked throughout by the accuracy and zeal characteristic of this master surgeon. He established beyond question his priority in this field of surgery, and won for him the appreciative recognition of surgeons everywhere. In 1878 Dr. John Davies Jackson, of Danville, Kentucky, supplemented the work of Gross by a memoir which verified the accuracy of Gross' investigations. In 1879 the Kentucky State Medical Society erected a monument over McDowell's grave in McDowell Park, in Danville. The dedication of the monument was most impressive, the principal address being made by Professor Gross. The proceedings of this occasion were published in the *McDowell Memorial Volume*, which was widely

distributed. In 1909, when a century had elapsed since McDowell's first ovariotomy, the American Gynecological Society held a meeting in New York City in his honor. Papers were presented by Fellows of the Society upon McDowell's life and original work, and representative surgeons from Great Britain, France, and Germany attended in person and presented papers paying tribute to McDowell's achievement. These papers were published in a special volume of the Transactions, marked *McDowell Centennial*. Dr. E. R. Peaslee dedicated his classic work on "Ovarian Tumors" to the memory of Ephraim McDowell, as did also Dr. Washington L. Atlee with his treatise on the same subject. Space will not permit even an enumeration of other proceedings and publications at home and abroad, which honor McDowell's memory. Upon the pages of every modern treatise on surgery and gynecology his name will be found.

During many years McDowell's operation (ovariotomy) failed to maintain professional approval, and even after anæsthesia was established for a long time it had few followers. It was bitterly opposed, and its followers denounced by many in high places; but practiced by a few brave spirits who carried on despite opposition and heavy mortality, it lived and grew in confidence. With the advent of the Listerian era it soon became the most successful major operation in surgery. From ovariotomy as a starting-point, surgery extended its domain to all the organs touched by the peritoneum. The original work of McDowell thus provided the fundamental knowledge which culminated in modern abdominal surgery, the crowning glory of the surgical art.

L. S. McMURTRY.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

Regular Meeting Held November 3, 1922, Dr. Frederick G. Dyas, Presiding

PERI-ARTERIAL SYMPATHECTOMY

Dr. Albert E. Halstead and Dr. Frederick Christopher: V. P., a Pullman conductor, age 55, was admitted to the medical service of Dr. Arthur R. Elliott, at St. Luke's Hospital, Chicago, on April 6, 1921. A tentative diagnosis of endarteritis obliterans was made by the admitting physician. Six weeks previous to admission the patient's right foot began to be painful and feel numb, which symptoms have become progressively worse. The pain radiated to the calf of the leg and the ankle felt weak. The patient was unable to walk more than half a block at a time and for the last 4 days and nights the pain has been excruciating and has prevented sleep. There had been no similar attack and the foot had not swelled. The patient had typhoid fever and "soft chancre" at 17 years of age, but otherwise the past history was negative. The family history was negative.

The physical examination revealed that the right pupil was slightly larger than the left and that both pupils reacted rather sluggishly to light and accommodation. The musculature of the extremities was fairly well developed—no paralysis, no tenderness save in the right foot which was painful when manipulated and to a lesser extent the right calf when palpated. The body was otherwise that of a normal healthy man.

On April 9, 1921, the blood sugar was 0.091 per cent, the blood urea nitrogen 17.47 milligrams per 100 cubic centimeters, the total non-protein nitrogen was 38.95 milligrams per 100 cubic centimeters. The Wassermann was clearly negative. There were 4,080,000 red blood cells, 10,050 white cells, 90 per cent hæmoglobin. The urine showed a faint trace of albumin, a few hyaline casts, no sugar, occasional leucocytes. A diagnosis of endarteritis obliterans was made by Dr. Arthur R. Elliott and Dr. George W. Hall.

The patient was given 4 liters of Locke's solution daily by mouth, and the duodenal tube and hot fomentations were applied to the foot. He made some improvement. On April 26, 1921, the patient was getting sodium citrate, 120 grains, Locke's solution, 64 ounces, potassium iodide, 30 grains, sodium bromide, 20 grains, chloral hydrate, 5 grains. After a few days the sodium citrate, sodium bromide and chloral were discontinued. On May 1, nitroglycerin, 1/100 grain every 2 hours for 8 doses daily, was started and continued for a week. On May 17, thyroid extract, 5 grains twice daily, was started and on May 19, sodium nitrite, 2 grains every 4 hours. On the 27th the electric oven was tried on the foot and nitroglycerin substituted for sodium nitrite. On June 4, massage of the leg was started. On June 24, 300 cubic centimeters of ½ per cent sodium citrate was given intravenously. The condition was unchanged throughout. On August 13, the patient was seen by Dr. Albert E. Halstead, who advised an attempt at periarterial sympathectomy or else an amputation.

On the 24th, the patient was transferred to the surgical service of Dr. Albert E. Halstead. Operation was performed on August 26. The femoral artery of the right leg was dissected out, so that the junction of the middle and lower thirds was visible. The adventitia was incised with great care and stripped completely off for a distance of 5 centimeters. The wound healed rapidly and cleanly, and the patient was discharged on the thirteenth day after operation, September 8, 1921. On July 21, 1922, 10 months after operation, the patient was admitted to St. Luke's Hospital for carbuncle of the neck. Operation of incision and drainage was carried out.

He is working as a cashier in a restaurant and is on his feet most of the 12 hours which he is on duty. He is able to walk a mile or more. There is no pain in the leg except a slight one if he walks rapidly. Numbness which was present at the time of operation has practically all disappeared. Before the operation the patient was unable to do anything and the pain was most severe when lying in bed. Now there is no pain. His general health is excellent. Leg used to be cold but gets warm in bed now. Tactile and thermal discriminations are normal. The scar is pale and the wound cleanly healed.

DISCUSSION

Dr. R. W. McNealy: My experience with the operation of peri-arterial sympathectomy as practiced by Leriche is limited to three cases. For the privilege of operating on these cases I am indebted to Drs. Cubbins, Speed, and George Davis, as they were transferred to me from their services at Cook County Hospital. The first case was that of

a man, 38 years of age, who came with a diagnosis of Raynaud's disease. He gave a rather typical history, and at the time he entered my service was unable to walk, as a result of pain and impending gangrene of one toe. At operation the peri-arterial sheath of the femoral artery was removed over a distance of about 7 centimeters. Within a few days he complained less of pain and in 10 days left the hospital with an improvement in the peripheral circulation in the extremity and able to walk with no pain.

The other two cases were cases diagnosed as endarteritis obliterans, in men 30 and 35 years of age. Similar technique was used on these patients and a transient improvement seemed to follow, but gangrene made it necessary to do rather high amputations in both cases at a subsequent date. Microscopic and macroscopic examination in these cases makes me very skeptical of the advantage of this operation in this particular group of cases. The lumens of these vessels we reduced to exceedingly small channels and their walls were thick and irregular. The slight dilatation following operative work seems too limited to do much, and I feel that one must place little hope in successfully combating cases of endarteritis obliterans. They can be saved much time and suffering by high amputations, i.e., above the popliteal bifurcation. In conclusion, I may say that the operation is not as simple as it would appear in the hands of a skillful surgeon like Dr. Halstead. I firmly believe it has a useful field, especially in the so-called neurovascular conditions.

Dr. David C. Straus: I wish to report my experience with peri-arterial sympathectomy in two cases of thrombo-angeitis obliterans. I believe these were the first two cases of peri-arterial sympathectomy performed in Chicago for this condition. They were both on my service at the Michael Reese Hospital.

The first case, a male patient, 48 years of age, came to the Michael Reese Hospital, January 1, 1922, with the typical symptoms and findings of thrombo-angeitis obliterans of the right foot, of four weeks' duration. The entire foot was cold and dry; all toes were red and swollen, but the condition was most marked in the right first toe, which was slightly cyanotic and distinctly tender, and pain was so severe as to prevent sleep.

Since reading Leriche's article on periarterial sympathectomy, which he read before the American Surgical Association, and which was published in the *Annals of Surgery*, October, 1921, I had been eagerly awaiting an opportunity to try his operation. However, before resorting to this measure in this case I decided to give the patient the benefit of the Koga method of treatment, that is, the introduction beneath the skin of Ringer's solution every second day, and this was carried out from January 5 to January 28. I was the first to use this method in Chicago, and my report[1] of two cases before this Society in 1915 was the first report in the American literature on this subject.

The patient was given 2000 cubic centimeters of Ringer's solution subcutaneously every second day from January 5 to January 13. From January 13 to January 28, he drank 4,000 to 5,000 cubic centimeters of Locke's solution and 5000 cubic centimeters of water every 24 hours. In spite of this treatment, the condition of the great toe gradually became worse. Consequently on January 28 I felt justified in trying Leriche's peri-arterial sympathectomy. The right femoral artery was exposed, and its sheath was completely dissected away for a distance of 8 centimeters. As soon as this was done, the artery contracted to about one-third of its former diameter. The result following the operation was striking. That night the foot, which before the operation had been cold and dry, and reminded one of a cadaver, now became warm and perspired profusely, wetting the sheet. The pain, however, still continued temporarily. The next day the findings remained as just mentioned, except for the fact that the toes were now less swollen and less red. The second day after the operation another interesting phenomenon was observed. While there was less swelling than on the day immediately after the operation, there were periods during this second day during which the swelling would suddenly appear and be more marked than it had been at any time, and then suddenly disappear again, i.e., vasomotor upset. This occurred several times during the day. This phenomenon continued for 2 more days and then disappeared. With its disappearance the pain entirely subsided, the foot remained warm and moist, and the operation seemed a great success.

However, although the foot remained warm and moist, the great toe gradually underwent dry gangrene and with this there was the usual pain. On March 9 the great toe was disarticulated, and the patient was discharged, March 27, 1922, with the wound entirely healed. Although the operation did not succeed in saving the great toe, yet the results were very encouraging and the operation seemed to hasten the formation of the line of demarcation.

The second patient, a man, 31 years of age, entered the hospital, December 14, 1921, because of pain in the second toe of the right foot which had been present for 6 weeks. This prevented sleep and was associated with a feeling of coldness of the entire foot. The toe was not swollen, but was slightly discolored, cyanotic and cool and tender on palpation. The third toe showed similar findings, but to a less degree. The history and findings were typical of thrombo-angeitis obliterans. The patient was put on the Koga treatment, but with only slight success. The first patient mentioned above had just recently been operated on and was so delighted with his result that he strongly advised this patient to undergo the same operation. On February 9, peri-arterial sympathectomy was performed as no real improvement had taken place. I exposed the femoral artery high up and completely removed its

[1] Surg., Gynec. & Obst., 1915, xxi, 534-535.

sheath for a distance of about 5 centimeters. The artery was not much larger than a lead pencil and when its sheath had been removed the artery contracted to about one-third of this size. From the day after the operation there was no more pain. The cyanosis of the second and third toe was less marked, but did not entirely disappear. The entire foot was warm and felt comfortable. The patient was delighted to be relieved of the cold sensation of the foot. He was discharged on February 20 and was advised to return if the pain recurred.

He returned to the hospital on April 14, with gangrene of the second and third toe. These were amputated by Dr. Bettman. As the foot did not do well, and the gangrene spread, Dr. Bettman performed an amputation through the lower third of the thigh on May 5. Patient was discharged May 31, the stump being entirely healed.

Leriche in his report stated that he had performed his operation 64 times. He had no case of thrombo-angeitis obliterans. He had one case of intermittent claudication and one case of erythromelalgia, but in both of these the operation failed. In my two cases the immediate effect of the operation was exactly as that described by Leriche. The primary contracture occurs as soon as the sheath of the artery is removed and lasts from 5 to 15 hours. After this time the secondary vasodilatation occurs. This is evidenced by the local elevation of temperature (2 to 3 degrees), sweating, and the subjective sensation of warmth. This vasodilatation is only transitory, becoming attenuated from the fifth to sixth day, and disappears entirely after 3 or 4 weeks.

The beneficial results from peri-arterial sympathectomy are often only temporary as in my two cases. This is probably explained by the fact that the sympathetic nerves regenerate very quickly, or by the fact that the vasodilator reaction is only transitory.

Dr. Daniel N. Eisendrath: We have had a large number of these cases at the Michael Reese Hospital in all stages. I tried the operation recommended by Lilienthal of dividing the greatly enlarged nerve on the coat of the femoral artery without any relief. I think Dr. McNealy's point is well taken, as emphasized by Dr. Straus. The Leriche operation for thrombo-angeitis obliterans is only applicable to cases in the early stages. Our experience at the Michael Reese Hospital is one of the largest in the city. We seem to have among the younger Jewish people of 30 or more a number of these cases. The youngest patient I have seen was 25 years of age. We get these cases up to 40 and 45 years of age. We find on dissecting these limbs what Dr. McNealy said, namely, once the condition has gone beyond the blue stage and there is threatening gangrene, the thrombosis is not only present in the immediate vicinity of the threatened gangrenous area, but it extends up usually to the point of the popliteal bifurcation. For that reason we find in many instances that it is of no benefit to amputate the toes. We are forced gradually to amputate higher and higher until we get finally to the point where a Gritti-Stokes or high thigh amputation must be done.

The result in Dr. Halstead's case was excellent, and the operation is well worthy of trial in the early cases. Once the artery is extensively thrombosed, it is perfectly useless from a theoretical standpoint to operate.

Dr. Halstead (closing): It is a well known fact that in endarteritis obliterans the trouble begins at the bifurcation of the popliteal. This was pointed out by Schede many years ago who advocated in all cases in which the gangrene had involved the dorsum of the foot, amputation above the knee. It goes without saying that an operation of this kind would not do any good, although it has been tried. When you have a favorable result from this operation you can make up your mind it is not an obliterating endarteritis.

The operation has been performed for too many conditions to make one think well of it, but in trophic disturbances and in cases where there is a vasomotor basis for the trophic disturbances, it is well worthy of trial. It is a simple operation, and I can see no reason why there should be any mortality with it.

Dr. Eisendrath: I would like to ask Dr. Halstead if he distinguishes between obliterating endarteritis as we used to consider it, namely, when the disease occurs more particularly in older patients, or whether he speaks of thrombo-angeitis obliterans which occurs in young people.

Dr. Halstead: I think it is the same thing.

A NEW METHOD OF GALL-BLADDER DISSECTION WITH A CONSIDERATION OF THE SURGICAL ANATOMY

Dr. Golder L. McWhorter read a paper entitled "A New Method of Gall-Bladder Dissection with a Consideration of the Surgical Anatomy." (See p. 256).

DISCUSSION

Dr. Daniel N. Eisendrath: The method described by the essayist is easy in patients who have not much inflammatory disturbance. We so often have great infiltration of the peritoneum and tissues around the junction of the cystic and hepatic ducts, where these anomalous vessels lie.

My great objection to beginning dissection at the fundus is that in case of great infiltration of the gall-bladder wall, it is impossible to secure a subserous separation and we have so much bleeding from the gall-bladder bed and the tissues around the neck of the gall bladder are so stained and infiltrated with blood that it is difficult to distinguish them. I believe in these cases one accomplishes more by avoiding the point that the essayist emphasizes in his technique in trying to mobilize the gall bladder from its bed, because the blood flows down and

obscures the common and hepatic ducts, and prevents us from identifying the very structures we most desire to avoid injury to.

The essayist's method is based to a great extent upon a need for cholecystectomy alone, but as gall-bladder surgery advances that is not enough. Everybody who does this work must be able when he finishes the operation, to feel confident that he is not obliged to operate a second time to find something in the common duct that he should have found the first time. I remove the gall bladder last of all, after inspecting and opening the common duct, wherever indicated.

It is unfortunate in giving his anatomical observations that the essayist did not quote the statistics of Rio Branco and Descomps who laid the foundation for the study of all of these anomalies, and also that he did not say a little more about the anomalies of the mode of union of the cystic and hepatic ducts, because it is not only blood-vessel injury that occurs by putting a clamp blindly on the cystic duct, but also common and hepatic duct injury. The inexperienced operator by doing what Dr. McWhorter has shown here, using clamps around the hepatic and cystic ducts is apt to include in badly inflamed cases more of the tissues than desired. I have adopted the technique of isolating these structures and of actually seeing what I am doing before I proceed further, and never put on a clamp. I use a ligature carrier and ligate the cystic duct separately from the vessels. I want to see the cystic duct isolated from the cystic artery before ligation, and not catch them together in a clamp or a ligature.

This work of Dr. McWhorter's is a step in advance, and it is very gratifying because at the time I presented a paper on vessel and duct anomalies before the society, we were told that this was of theoretical rather than of practical value. I have heard from various surgeons in all parts of the country since, who are paying more and more attention to these anomalies than was done a few years ago that they are grateful for having their attention called to these anomalies.

Dr. McWhorter (closing): With reference to the statement made that practically this same method has been used before, I will say that I have looked through all available textbooks and the literature very carefully since I developed it and I have been unable to find anything that could be called a similar method. The lateral incision may have been used in conjunction with the older methods of freeing the bladder, but the steps of this method are the lateral approach freeing the bladder posteriorly first at the pelvis, and then dissecting down posteriorly to the cystic duct, which is freed with the distal ligation of the branches of the cystic artery in their mesentery. I feel that this method has never been used before.

Going through the left fold of the peritoneum is a step which proves that you have dissected the lower end of the gall bladder completely from its bed and is not a necessary step of the operation. This bed in the lower end of the gall bladder may be liver or connective tissue. In many of these gall bladders there is a liver attachment to the larger portion, but when you get near the cystic duct, it is loose connective tissue, making it easy to dissect in these cases from the posterior approach.

Dr. Eisendrath suggests that it would be a difficult operation in cases in which there is infiltration of the gall-bladder wall. I shall simply say that I developed this technique clinically on a particularly difficult case. The gall bladder was thickened, œdematous, friable, and contained many stones. I aspirated the gall bladder and obtained only a small amount of fluid. The gall bladder was still distended, friable, and congested. Since in previous cases I have had considerable bleeding from attempting to dissect from the fundus down, I dissected from the lateral side and approached the cystic duct posteriorly, and the method worked out almost by itself. For me, at least, I have found this method of decided advantage, and I feel safer in doing it than I have felt with any other method.

Bleeding from the gall-bladder bed on the liver, as Dr. Eisendrath said, does occur. It occurs in a dissection from the fundus down and I did not try it on this particular case because I knew there would be a lot of bleeding, since the condition was acute and the gall bladder was gangrenous in one area. Since using the method described, it has been my experience that the larger blood vessels come into the body of the bladder from the liver above the region that is first freed. Consequently there is practically no bleeding. There may be some oozing at first, but it is infinitesimal, and I have never dissected the duct in a bloody field by this method.

As to the reference to findings by other anatomists and comparing them to mine, I did not wish to make my paper too long. I wanted to bring out the anomalies, in order to emphasize the safety of my method especially where the cystic duct is dissected from the neck down so that there could not be any anomalous hepatic branch going into the bladder, or so that the cystic duct could not empty, anomalously, into the right branch of the hepatic duct without its being recognized before cutting. This might happen easily if the cystic duct were freed first at the junction with the common duct and cut before its complete dissection to the bladder. In my method, where the neck is exposed from behind the sheet of peritoneum, and in the presence of peritoneal adhesions, the dissection is easier posteriorly. In the loose connective tissue and in œdematous tissues, the removal posteriorly is even easier than normally. If you approach it anteriorly, the dissection becomes very difficult.

Dr. Einar Key, Stockholm, Sweden, read a paper on "Extrapleural Thoracoplasty in the Treatment of Pulmonary Tuberculosis."

Dr. Emil Beck read a paper entitled "Further Progress on the Open Method of Treatment of Inoperable Carcinoma."

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis, Missouri

IN order to give it due emphasis, I have placed at the head of this "Critique" a work which, to my mind, marks a very notable addition to medical literature. In a monograph[1] of little more than 200 pages Ehrenfest deals with the subject of birth injuries of the child, setting himself the task of inquiring into the danger of birth to the infant, its relative frequency and seriousness, its causes, methods of diagnosis, of prevention, and of treatment. Never before has this subject received so exhaustive a consideration, and the book before us represents a truly encyclopædic completeness. In seventeen chapters, injuries of the scalp, the cranial bones, the intracranial contents, the vertebral column and spinal cord, the face, eye, neck, clavicle, thorax, abdomen, extremities, etc., are discussed with a comprehensiveness which neglects no essential detail. The author modestly remarks in the preface that, probably, omissions may have occurred; but a glance at the references appended to each chapter gives one the impression that at any rate no important contribution has been overlooked. The enormous mass of literature which has been collected from all parts of the civilized world, not only attests to the amazing industry of the author, but it is presented with so much critical judgment and such freshness of style that the study of the book is of absorbing interest.

The first effect of such a work must needs be on the practice of obstetrics. It should, nay, it must make better and more careful obstetricians of those who attend women in confinement. But beyond our special field the book presents reliable information and, thus, helpful suggestions for treatment to specialists in other fields of medical practice, and it thereby links obstetrics closely with pediatrics, neurology, ophthalmology, surgery, and orthopedics. And if ever the time comes when special experts in forensic medicine are recognized and demanded, this book will probably serve as a reference work in our courts.

AND here is another work that will make for better obstetrics—an excellent book which I could not lay down after I had once started, until I had read it from cover to cover. A "Course on the Mannikin"[2] it is called, and the author introduces it with the statement that it has merely been his aim to guide the student until he may become proficient in the proper obstetrical technique in the great school of actual practice. But he has given us much more than he promised. So graphic are his instructions, so epigrammatic and impressive his diction, so true and plastic the numerous illustrations that the book embodies a large part of obstetrical education. The obstetrical teacher should be glad to arrange his course along the lines indicated by a man of great teaching ability and thorough familiarity with the needs of daily practice. The practitioner who is only too apt to follow a rut and forget the finer points taught him in school, would do well to read this small book from time to time. Such a review would be particularly desirable after a difficult case so as to avoid complications the next time. The student, finally, can wish for nothing better than this book to complement the spoken word of his teacher and the actual exercises on the mannikin.

The book is, in the main, divided in five chapters dealing, respectively, with delivery in vertex presentation, transverse position, breech and unfavorable vertex presentations, the various methods of artificial dilatation, and the mutilating operations. It lies in the very nature of the subject that there is nothing absolutely new that is here presented. It is more in the way in which the problem is approached that the value of this book is to be found. Of the original, and previously published, contributions of the author, his "Kegelkugelhandgriff"—the introduction of the entire hand in cone shape for purposes of traction and rotation—and the use of a specially constructed lamp wick for traction on the high breech may be mentioned.

At the end of the book there are about six pages of aphorisms—Golden Rules, indeed, which may well be memorized by anyone engaged in obstetrical work. One example only: "Rule 5. He who applies forceps in incomplete dilatation or on the floating head, is responsible for the consequences. Many a one thought to save a child and destroyed two lives: mother and child."

I accompany the announcement of this book with my warmest recommendations.

THERE is in the human mind a static element that distrusts the new and clings to the old. Every discovery and every movement for reform

had to count with, and battle against, this factor. In medicine it has had its good sides in so far as it sometimes prevented a headlong acceptance of poorly founded claims, but it also has often retarded progress as in the case of Semmelweiss or McDowell. And so with these last named examples in mind, I wish to disclaim any *a priori* critical attitude toward the book before me[1] merely for the reason that it contains something entirely new. For, while version has been performed since the days of Soranus of Ephesus, and while many of the special manœuvers may have been familiar to this or that man in the past, yet, what Potter practices and teaches regarding version, is undoubtedly new, is essentially unprecedented. Who has ever before said—perhaps not exactly in these words, but in words to that effect—that the physiological mechanism of childbirth which obtains in 95 per cent of all cases, is deficient and causes more injury than a properly executed podalic version? That the convenience of the obstetrician should be one of the guiding indications for terminating labor? That podalic version, or rather, the right kind of podalic version will check the decline of the birth rate, particularly in the more intelligent and far-seeing part of the population?

No, we must assuredly give the credit of priority to the man who has deliberately broken away from the accepted standards of obstetric practice, and we are filled with a feeling akin to awe when we read that within the past 2 years the author has accomplished the colossal task of personally delivering 2,243 women, in whom he has performed version in 1,908 instances. In this monograph Potter gives a very clear and well illustrated description of his technique, presents his statistics, replies to certain criticisms of his procedure, enumerates its indications and advantages, and concludes with a plea for a universal adoption of his method.

To one who has no personal experience with the Potter version, it is obviously unbecoming to criticize the technique, particularly when the results testify to the stupendous dexterity of its originator. In fact, the reading of the sixty odd pages which deal with the author's method—and they are quickly read—gives one the impression that here is a mode of delivery that is applicable in practically all cases, normal and abnormal alike, and has no shortcomings. But a second reading makes one pause and question whether this monograph is, after all, a scientific book in the strict sense of the word.

When a startlingly new and radically different method is recommended, one would expect to find somewhere a comparison of statistics which would demonstrate in a mathematical and convincing fashion the superiority of the new over former methods in vogue. Unfortunately, such comparative statistics are lacking, though it would have been an easy matter to procure them.

The surgeon who habitually opens bellies to see "what is in them," is justly considered an empiric no matter how skillful he may be. Yet, this is precisely what Potter advocates in childbirth. He scorns all methods of obstetrical diagnosis, in particular pelvimetry, and immediately proceeds to version. Thanks to his expertness and thanks, most likely, to the fact that most pelves are normal or nearly normal, he succeeds, but if such is not the case, cæsarean section must follow. This inference impresses itself upon one's mind and it explains perhaps the 180 cæsarean sections among the 335 cases which were not delivered by version, a relative percentage of almost 54 and an absolute percentage of 8 which even in the present surgical era of obstetrics seems excessive. But granting the necessity for so large a number of cæsarean sections, would not a comparison of the mortality and morbidity of these operations with those performed under accepted indications, have greatly added to the value of the book and testified to the fairness of the author?

For these reasons the monograph somehow resembles a propaganda work, and like all other propaganda writings for whatever purpose, it distributes light and shadow unevenly.

While, thus, the book by its tenor and its construction lays itself open to criticism, no such censure applies to the personal adroitness of its author. And as to generalization? It is true that Blondel crossed the Niagara on a tight rope, but the rest of the people have always preferred the bridge across.

Yet, Potter must be considered a pathfinder. Already there are indications of it discernible—his method of "ironing out" the vagina, for instance, his protection of the mouth against aspiration, etc.

In fifty years from now a medical historian will probably consider this monograph a most interesting document of the development of obstetrical art. In the meantime let us add what seems of permanent value in Potter's method, to our obstetrical armamentarium.

A REVIEW on Koblanck's Manual was barely published in this journal[2] when the third edition of this little book[3] appeared—a sufficient proof, it seems, that the favorable opinion expressed by me has been shared by a great many others. As a matter of fact, this booklet which in its new form has increased by almost a hundred pages, meets in a most satisfactory fashion the practical needs of the specialist and the general practitioner and is particularly well adapted to the requirements of office work.

THE new edition of Crossen's textbook[4] has been improved by the addition of numerous good microphotographs and a thorough revision of the

[1] The Place of Version in Obstetrics. By Irving W. Potter, M.D., F.A.C.S. St. Louis: C. V. Mosby Co., 1922.

[2] Surg., Gyn. & Obst., 1922, XXXV, 285.

[3] Taschenbuch der Frauenheilkunde. By Prof. Dr. Koblanck, 3rd ed. Berlin and Vienna: Urban & Schwarzenberg, 1921.

[4] Diseases of Women. By Harry Sturgeon Crossen, M.D., F.A.C.S. Third ed. St. Louis: C. V. Mosby Co., 1921.

text by the author and several collaborators. The steady appearance of new editions of this work attests to its well merited popularity among students and practitioners and confirms our previously expressed comments.

THERE are several reasons why a new obstetrical textbook for nurses should be reviewed in the columns of SURGERY, GYNECOLOGY AND OBSTETRICS. To begin with, those among the readers of this journal who are teachers in training schools want to know of a really good textbook to use for their lectures. Furthermore, all practicing obstetricians should be thoroughly conversant with the treatment of labor and puerperium as it devolves upon the nurse, but the details of this treatment are for lack of space but indifferently considered in obstetrical textbooks for students and practitioners. Finally, we all are vitally interested in any work that will help to elevate the standard of obstetrical nursing in this country. This task has been admirably well solved by Carolyn Van Blarcom.[1] As the educational requirements of nurses' training schools are widely different, it is by no means an easy matter to find just the right meeting ground, avoiding on the one hand a dogmatic brevity which furnishes no foundation for real understanding, and on the other, an exhaustive study of particulars that are clearly outside of the nurse's province. Miss Van Blarcom has evaded Scylla and Charybdis, and the way in which she describes the underlying principles of obstetrical nursing as well as the various nursing methods appeals to me as altogether praiseworthy. It is her twofold aim to prepare the nurse to be an intelligent helper to the physician in all obstetrical problems and to instill in her a sense of the great service she may be able to render mankind. One can only subscribe to the author's four cardinal requirements of the truly good nurse, namely:

1. Cleanliness—under all conditions, to protect both mother and baby from infection.
2. Watchfulness—for early symptoms of complications in either mother or baby.
3. Adaptability—to the patient, the doctor, and the surroundings.
4. Sympathy—for every mental and physical stress which the patient may suffer.

The practical value is still further enhanced by the author's instructions how hospital procedures and appliances may be improvised in a patient's home whether in a city or a rural community. The numerous illustrations, whether photographs or line drawings, are very instructive. Only one picture, that of a woman in knee-chest posture, is incorrectly drawn with the spinal column arched and should be changed in the next edition. And speaking of pictures, I wonder whether the author could not find a more radiant, a more compelling representation of young motherhood for her frontispiece. However, these are very minor details which in no way affect the great value of this book.

[1] Obstetrical Nursing. A textbook on the management of the woman in labor, the young mother and her baby. By Carolyn Conant Van Blarcom, R.N. New York: The Macmillan Company, 1922.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

L'ANESTESIA LOCALE IN CHIRURGIA PEDIATRICA ED IN ORTOPEDIA. By Dr. Oreste Nuzzi. Bologna: Licinio Cappelli, 1922.

FERITE DEL TORACE. 2d ed. By Dott. Prof. Felice Rossi. Bologna: Licinio Cappelli, 1922.

IL TAGLIO CESAREO ABDOMINALE. By Dott. Pietro Gall. Bologna: Licinio Cappelli, 1922.

ORGANIZZAZIONE E INSEGNAMENTO NELLA SEZIONE CHIRURGICA OSPEDALIERA. By Dott. Aldo Lesi. Bologna: Licinio Cappelli, 1922.

OBSTETRICS FOR NURSES. By Everett Dudley Plass, M.D. New York and London: D. Appleton & Co., 1922.

EXAMINATIONS IN THE LABORATORY AND WARD. A Contribution to the Methods of Medical Study and Gynecology. By W. J. Stewart McKay, M.B., M.Ch., B.Sc. New York: William Wood & Co., 1922.

THE VARIOUS OPERATIONS ON THE FEMALE PERINEUM. By F. A. Maguire, D.S.O., M.B., Ch.M. (Syd.), F.R.C.S. (Eng.). Sydney: Angus & Robertson, Ltd., 1922.

GYNECOLOGICAL AND OBSTETRICAL PATHOLOGY. By Robert Tilden Frank, A.M., M.D., F.A.C.S. New York and London: D. Appleton & Co., 1922.

I BELIEVE IN GOD AND IN EVOLUTION. By William W. Keen, M.D. Philadelphia and London: J. B. Lippincott Co., 1922.

SURGERY. By Ivor Back, M.A., M.B., B.C., (Cantab.), F.R.C.S. (Eng.), and A. Tudor Edward, M.A., M.C. (Cantab.), F.R.C.S., (Eng.). London: J. & A. Churchill, 1922.

DIE LEITHMANN METHODE. By Dr. Victor Bock. Leipzig: S. Hirzel, 1922.

THE PROPAGANDA FOR REFORM IN PROPRIETARY MEDICINES. vol. ii. Chicago: American Medical Association, 1922.

REGIONAL ANESTHESIA; Its Technic and Clinical Application. By Gaston Labat, M.D. With a Foreword by William J. Mayo, M.D. Philadelphia and London: W. B. Saunders Co., 1922.

TEXT BOOK OF PHYSIOLOGY. By Dr. Landois. Edited by Prof. L. Luciani. Translated and edited by Henry Patten Sedgwick, B.S., M.D., and Carl Ahrendt Scherer, M.D., F.A.C.P. Philadelphia and London: J. B. Lippincott Co., 1922.

AMERICAN COLLEGE OF SURGEONS

STATISTICAL REPORT OF HOSPITALS MEETING THE MINIMUM STANDARD

ON the following page is a reproduction of the large map at the College headquarters, used to give an impression as to the general geographical distribution of hospitals with special designation of the approved institutions. The general distribution of hospitals, as would naturally be supposed, coincides with the density of the population, the clusters of hospitals on the map indicating the larger cities. It also brings out clearly the extreme scarcity of hospitals having fifty or more beds in certain sections of the country, especially in the Western states. In some regions, notably in the mountainous sections, one must travel almost the entire width of a state or province before finding a hospital of appreciable size.

In this map the approved hospitals are indicated by red stars and red crosses and hospitals which are not approved are indicated by black dots and black crosses, denoting in each instance the 100-bed and 50-bed hospitals respectively. A glance at the map, therefore, gives a general estimate of the proportion of approved institutions in a given section of the continent by the relative number of red and black figures.

The statistical table on page 00 gives the exact percentage of approved hospitals in each state and province, the table being subdivided into three subdivisions: hospitals having 100 or more beds; those having 50 to 100 beds; and a third subdivision including all hospitals having over 50 beds.

It is rather remarkable that, considering all hospitals having over 50 beds, there is such a small variation between the percentage of approved hospitals in the United States and Canada, namely, 62.5 per cent and 64.6 per cent respectively. This demonstrates that there is a uniformity in statistics covering hospital conditions, provided that the statistics cover a wide range of territory, as separate statistics for the United States and Canada each cover a territory extending from coast to coast and include both metropolitan and rural communities.

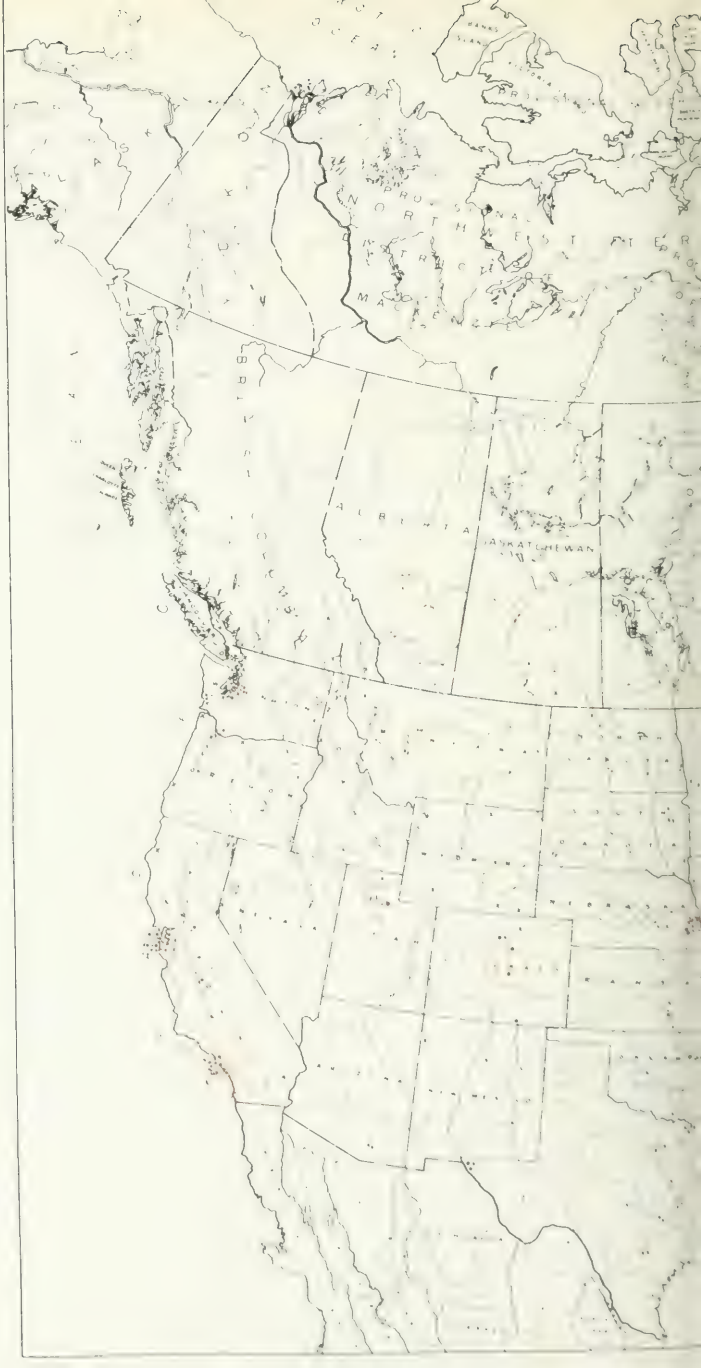
When statistics for states and provinces are compared separately, however, there is a certain element of unfairness which enters, due to the variation in the number of hospitals in the various states and provinces. For example, in the statistics covering the 100-bed hospitals, each state or province having 100 per cent of its hundred-bed hospitals approved has less than 10 hospitals of this size, with the exception of Maryland, Michigan, and Minnesota, which states have 14, 23, and 24 hundred-bed hospitals respectively—a very commendable showing. The seven states having 30 or more hundred-bed hospitals rank as follows: Ohio, 94.6 per cent approved; Massachusetts, 92.8 per cent; Pennsylvania, 89.4 per cent; New York, 84.4 per cent; California, 68 per cent; New Jersey, 82.4 per cent; and Illinois, 63.5 per cent approved.

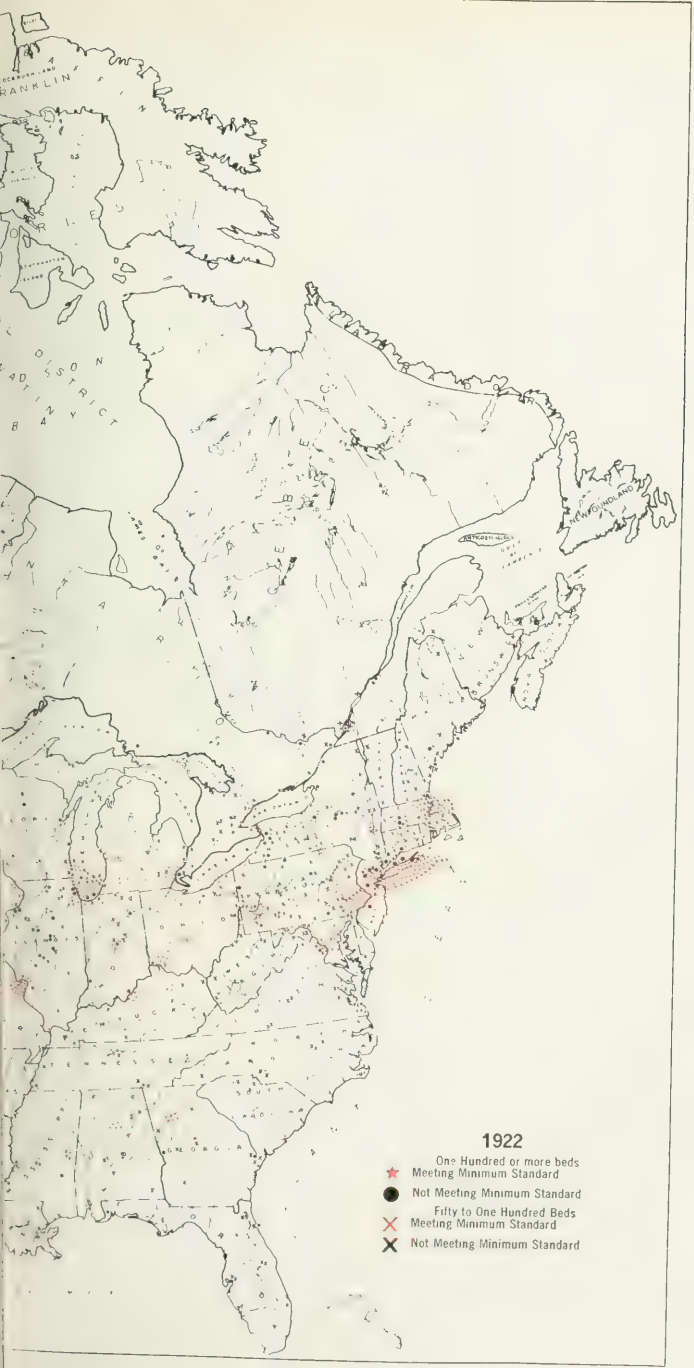
In the table of hospitals having from 50 to 100 beds, there is only one state or province having 100 per cent approved, namely, Alberta, which, however, has only two hospitals of this size. Those states or provinces having 30 or more hospitals with a capacity of from 50 to 100 beds rank as follows: Ohio, 71.4 per cent, approved; New York, 44.2 per cent; Pennsylvania, 42.2 per cent; Ontario, 36 per cent; Massachusetts, 31.4 per cent; and Illinois, 30.8 per cent, approved.

Considering all hospitals having over 50 beds, the seven states and provinces having 50 or more hospitals compare as follows: Ohio, 83.3 per cent; Pennsylvania, 67.5 per cent; New York, 67.3 per cent; Massachusetts, 65 per cent; California, 53 per cent; Ontario, 50 per cent; and Illinois, 48.7 per cent, approved.

The statistics in the above three paragraphs refer only to those states and provinces having the largest number of hospitals, the percentage of some of these being exceeded by other states and provinces having not quite as many hospitals.

The grand totals, combining the hospitals in the United States and Canada, are as follows: Out of 812 hospitals having 100 or more beds there are 677 or 83.3 per cent approved. Of those having 50 to 100 beds, 42.2 per cent or 342 of the 811 institutions meet the standard, and including all the 1623 hospitals having over 50 beds, there are 1019 or 62.7 per cent on the approved list.


ALASKA
YUKON
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
NORTHWEST TERRITORIES


1922
One Hundred or more beds
Meeting Minimum Standard
Not Meeting Minimum Standard
Fifty to One Hundred Beds
Meeting Minimum Standard
Not Meeting Minimum Standard

NUMBER OF HOSPITALS MEETING THE MINIMUM STANDARD

United States and Canada	100 or more Beds			50 to 100 Beds			All Hospitals over 50 Beds		
	Number of Hospitals	Approved		Number of Hospitals	Approved		Number of Hospitals	Approved	
		Number	Percentage		Number	Percentage		Number	Percentage
Alabama	9	8	90	8	3	37.5	17	11	64.7
Arizona	1	1	100	2	0	0	3	1	33.3
Arkansas	5	4	80	10	5	50	15	9	60
California	44	30	68	24	6	25	68	36	53
Colorado	13	9	69	4	2	50	17	11	64.7
Connecticut	15	12	80	8	1	12.5	23	13	56.7
Delaware	1	1	100	2	1	50	3	2	66.6
District of Columbia	10	9	90	3	0	0	13	9	69
Florida	4	2	50	9	2	22.2	13	4	30.8
Georgia	10	7	70	12	4	33.3	22	11	50
Idaho	1	1	100	7	4	57	8	5	62.5
Illinois	63	40	63.5	52	16	30.8	115	56	48.7
Indiana	16	12	75	17	9	53	33	21	63.6
Iowa	15	13	86.7	21	11	52.4	36	24	66.6
Kansas	6	4	66.6	19	11	58	25	15	60
Kentucky	8	8	100	14	5	35.7	22	13	59
Louisiana	7	6	85.7	7	2	28.6	14	8	57
Maine	5	3	60	7	1	14.3	12	4	33.3
Maryland	14	14	100	11	5	45.5	25	19	76
Massachusetts	42	39	92.8	55	11	31.4	77	50	65
Michigan	28	28	100	21	9	42.8	44	32	72.7
Minnesota	24	24	100	11	6	54.5	35	30	85.7
Mississippi	4	1	25	7	0	0	11	1	9
Missouri	24	22	91.7	20	10	50	44	32	73
Montana	5	5	100	11	5	45.4	16	10	62.5
Nebraska	9	6	66.6	10	3	30	19	9	47.4
Nevada	0			2	1	50	2	1	50
New Hampshire	1	1	100	8	4	50	9	5	55.5
New Jersey	34	28	82.4	11	7	63.6	45	35	77.7
New Mexico	0			3	0	0	3	0	0
New York	103	87	84.4	77	34	44.2	180	121	67.5
North Carolina	4	4	100	16	9	56.2	20	13	65
North Dakota	5	5	100	4	2	50	9	7	77.7
Ohio	57	55	94.6	55	25	71.4	72	60	83.3
Oklahoma	2	2	100	8	1	12.5	10	3	30
Oregon	4	4	100	11	3	27.3	15	7	47.6
Pennsylvania	85	74	80.4	71	30	42.2	154	104	67.5
Rhode Island	3	3	100	3	2	66.6	6	5	83.3
South Carolina	6	5	83.3	6	3	50	12	8	66.6
South Dakota	3	2	66.6	11	6	45.4	14	8	57
Tennessee	13	9	69	9	4	44.4	19	13	68.4
Texas	20	15	75	19	5	26.3	39	20	51.3
Utah	5	4	80	1	0	0	6	4	66.6
Vermont	1	1	100	5	3	60	6	4	66.6
Virginia	7	6	85.5	23	10	43.5	30	16	53.3
Washington	17	15	88	13	3	23	30	18	60
West Virginia	7	7	100	20	8	40	27	15	55.5
Wisconsin	20	16	72.7	24	13	54	46	29	63
Wyoming	0			6	1	16.6	6	1	16.6
Totals for United States	787	627	81	748	306	41.8	1442	933	66.5
Alberta	0	0	100	2	2	100	8	8	100
British Columbia	6	6	100	7	1	16.6	13	7	58.3
Manitoba	6	5	83.3	5	1	20	8	6	75
New Brunswick	1	1	100	8	7	87.5	9	8	62
Nova Scotia	3	3	100	7	6	85.7	10	9	90
Ontario	25	16	69.6	31	11	35	83	27	32.5
Prince Edward Island	0			3	2	66.6	3	2	66.6
Quebec	11	9	82	8	3	37.5	19	11	58
Saskatchewan	4	4	100	8	4	66.6	12	8	80
Totals for Canada	80	68	85.5	78	36	43.5	165	89	54.6
Grand Totals	867	695	85.8	826	342	41.8	1607	1022	63.6

ILLINOIS, INDIANA, MICHIGAN, AND OHIO SECTIONAL MEETINGS OF THE CLINICAL CONGRESS

ILLINOIS

THE Illinois State Sectional meeting of the American College of Surgeons was held in Quincy on Friday and Saturday, December 1 and 2. The arrangements for this meeting were in the hands of the local Fellows of the College with Dr. E. B. Montgomery as chairman. Registration headquarters was on the mezzanine floor of the Quincy Hotel. The usual hospital meeting took place on Friday afternoon at 2 o'clock in the Gold Room of the Hotel Newcomb. There was a good attendance and an exceedingly interesting discussion at the Round Table Conference.

The public meeting in the Presbyterian Church was packed to the doors by a large audience interested in the great movement for better health and better hospitals. Nurses from the Blessing Hospital acted as ushers. An innovation at this meeting was the broad-casting by radio of the various addresses. This arrangement was made by Dr. W. Stevenson of Quincy who is an enthusiastic radio fan, and to Dr. Stevenson and also to the local agents who so kindly provided the equipment, the hearty thanks of the College are due. This plan worked out splendidly as weather conditions were favorable and the voices of the speakers were distinctly heard over a distance of 300 miles. In addition to the representatives of the College, the following numbers were added to the program:

Address of Welcome. Bishop M. Edward Fawcett.

How the Public Can Assist in Reducing the Mortality from Cancer. Allen B. Kanavel, A.M., M.D., Professor of Surgery, Northwestern University Medical School, Chicago.

What Can Be Accomplished by Routine Prenatal Care. Charles B. Reed, M.D., Obstetrician, Wesley Memorial Hospital, Chicago.

Albert J. Ochsner, M.D., President-elect of the American College of Surgeons in a short address outlined how members were admitted to Fellowship in the College.

The musical numbers provided by Mr. and Mrs. William Spencer Johnson were very much appreciated, and our thanks are due to Mr. and Mrs. Johnson for their interest and co-operation in making the meeting so successful.

The scientific session met on Saturday afternoon in the Presbyterian Church. It was well attended and following the meeting the moving picture of the Boston Congress was shown for the first time. The scientific program was as follows:

Trigeminal Neuralgia—(Illustrated). Allen B. Kanavel, M.D., Chicago.

Surgical Lesions of the Large Bowel. Carl B. Davis, M.D., Chicago.

Some Complications of Appendicitis. Carl E. Black, M.D., Jacksonville, Illinois.

The Postmature Child. Charles B. Reed, M.D., Chicago.

Fracture of the Spine. John L. Porter, M.D., Professor of Orthopedic Surgery, Northwestern University Medical School, Chicago.

Partial Gastrectomy for Ulcer of the Lesser Curvature. Alfred A. Strauss, M.D., Attending Surgeon, Michael Reese Hospital, Chicago.

Surgical Aspect of Cancer. A. J. Ochsner, M.D., Professor of Surgery, University of Illinois College of Medicine, Chicago.

Surgical clinics and demonstrations were conducted at the local hospitals during the two days of the meetings and gave evidence of careful preparation and thought.

Immediately following the hospital meeting on Friday afternoon, there was a meeting of the Fellows of the College at which there was a good attendance.

INDIANA

THE Indiana Sectional meeting was held in Evansville on Monday and Tuesday, December 4 and 5. The headquarters and registration were at the Hotel McCurdy. The hospital meeting took place in the Ball Room of the McCurdy Hotel at 2 p.m. on Monday and was followed by the Round Table Conference and a meeting of the Fellows of the College. At this meeting of the Fellows a series of slides was shown illustrating the organization of the College and outlining the property owned and controlled by the College and the Journal. This was accompanied by a short address from the Director General.

The public meeting was held at the First Baptist Church, and although the weather was very unfavorable, there was a good attendance. In addition to the representatives of the College, the following numbers composed the program:

Surgery in Public Health. J. B. Deaver, M.D., Philadelphia

Trigeminal Neuralgia—(Illustrated). Allen B. Kanavel, M.D., Chicago.

Prenatal Care. Charles B. Reed, M.D., Chicago.

The scientific meeting was held in conjunction with the Ohio Valley Medical Society on Tuesday 1:30 p.m. in the Auditorium of the Young Men's Christian Association. The program brought up much interesting discussion.

The series of interesting clinics was conducted at the local hospitals. On Tuesday morning a clinic was conducted at the Walker Hospital clinic by Dr. John B. Deaver. The arrangements for this meeting were in the hands of the local committee with Dr. J. Y. Welborn as chairman. The success of the meetings was due largely to the energetic efforts of this Committee.

MICHIGAN AND OHIO

THE Michigan and Ohio Sectional meeting of the American College of Surgeons was held at the Gibson Hotel, Cincinnati, on Friday and Saturday, December 8 and 9.

The hospital meeting on Friday afternoon at 2 o'clock in the Ball Room of the Hotel was fairly well attended and called forth an animated discussion on various phases of hospital standardization and management. A meeting of the Fellows of the College followed the Round Table Conference. The organization of the College was outlined and illustrated by means of slides and a short address by the Director General.

The public meeting was held in the Ball Room of the Gibson Hotel at 8 p.m. on Friday. Dr. Charles L. Bonifield presided, and besides the representatives of the College the following interesting and instructive addresses were delivered:

Experimental Medicine. William D. Haggard, M.D., Nashville. Professor of Surgery, Vanderbilt University, Medical Department.

What Can Be Accomplished by Routine Prenatal Care. Charles B. Reed, M.D., Chicago. Obstetrician, Wesley Memorial Hospital.

Influence of Modern Medicine on Life Extension. Charles A. L. Reed, M.D., Cincinnati. Emeritus Professor of Gynecology, University of Cincinnati, College of Medicine.

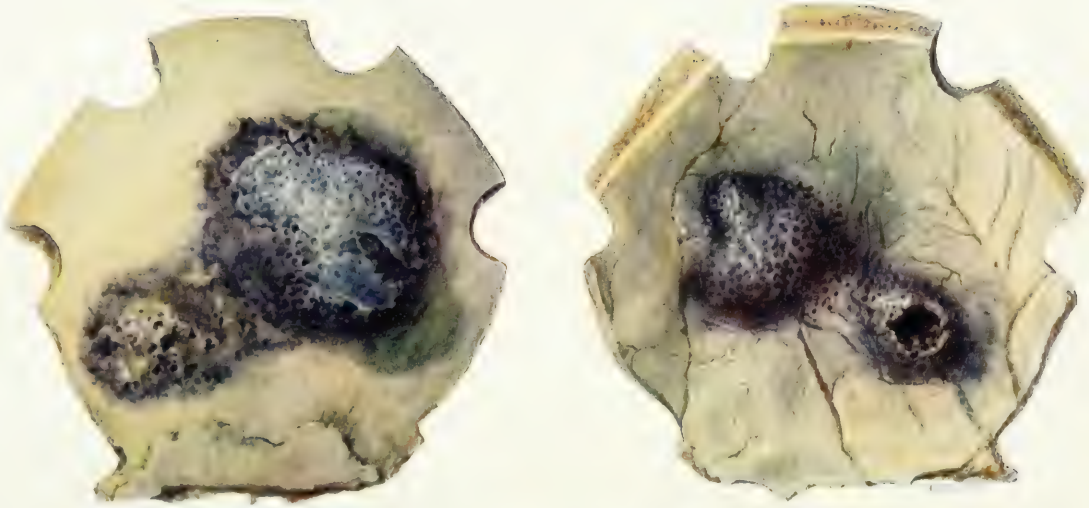
The scientific meeting was held on Saturday afternoon in the Gibson Hotel, and the following papers were presented:

Tumor of the Breast—A Study of 255 Cases. W. D. Haggard, M.D., Nashville, Tennessee.

Intra-Orbital Tumors. E. C. Ellett, M.D., Memphis, Tennessee.

The Postmature Child. Charles B. Reed, M.D., Chicago.

Clinics and demonstrations were conducted during the meetings at the city hospitals. These were very instructive and interesting to all those in attendance.



Figs. 1 and 2. Color-plate — natural size of the original bone flap showing at left the external tumor, and at right the internal tumor, the crater being the point at which the fragment was removed for examination.

SURGERY, GYNECOLOGY AND OBSTETRICS

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SURGICAL END RESULTS IN GENERAL

WITH A CASE OF CAVERNOUS HÆMANGIOMA OF THE SKULL IN PARTICULAR[1]

BY HARVEY CUSHING, M.D., F.A.C.S.

THE medical profession is essentially gregarious. There is no other profession equally so, and, because of this trait, the medical society, where experiences may be interchanged, becomes the most effective agency for the diffusion of knowledge—even more effective than our extensive literature. Certain kinds of information, however, are conveyed far better by onlooking than by studying the printed page, and in so far as surgery is a craft its newer lessons can best be transmitted by observing the manipulations of others.

In days gone by, all of our societies, even the strictly surgical ones, were almost wholly subjective in their methods of teaching. The members sat and listened to subjective expositions. This went on until 20 years ago, when a small group of American surgeons founded a society into which the opposite principle was introduced—the objective method of exposition. In rotation its members met in the several institutions they represented, in order to see one another at work—at the operating table, in the laboratory, at the bedside, in the classroom before their students. These meetings, at which no papers were read, proved a great success, and the established usage of this society has become widely copied, particularly by small groups of surgeons both at home and abroad. So great a success was it that the principle came to be adopted wholesale by the Clinical Congress of Surgeons, and so eager was the demand for the opportunities offered through this agency to see an entire community of surgeons engaged in their tasks, that the gatherings became utterly unwieldy.

Out of this has grown the present College, modeled in certain of its customs on the Royal College of Surgeons of England. But the chief function of the three Colleges of Surgeons of London, of Edinburgh and of Dublin, is that of a licensing body, and with this we have nothing to do. However, the founders of the American College had no intention of its becoming merely a club. They have set out deliberately to make a membership in the body highly desirable for other than social reasons.

Surgery has become the chief therapeutic resource of the profession. Those of us who engage in it are better aware than any others, of its commercializing opportunities and temptations, so largely the outgrowth of specialization. Accordingly, certain very-much-needed reforms have been inaugurated by the College—reforms the object of which is to render impossible the barter of patients on the part of those members of the profession, both in and out of our particular craft, who could never have read or pondered over the Hippocratic oath and who ignore the Golden Rule.

[1] Presidential Address before the Clinical Congress of American College of Surgeons, Boston, October 23, 1922.

But granting honesty of purpose and professional idealism in the vast majority, the College has set about further to safeguard those subjected to surgical operations in two ways: first, by putting its seal on those who may be considered sufficiently well trained to undertake major operations; and, secondly, by seeing to it that the hospitals in which such procedures are carried out are properly organized and conducted.

There may be some doubt regarding the entire success of the former endeavor—the fair bestowal of the College hall-mark. There are men both in and out of almost any society that can be named, who should not be. But there can be no question of the success of the movement for the betterment of the hospitals: and the educational campaign which has attended their survey has been of far-reaching importance. The laity and hospital Boards understand better what manner of man the surgeon should be and how hospitals should be conducted. The hospital surgeon, generally speaking, has come, on the other hand, to take himself and his institutional responsibilities far more seriously than once was his inclination.

With all this, the holding of these annual meetings has little to do. What is more, the large public operating clinics a relic of the original Congress, lie open to very serious temptations and objections. Few surgeons can do their best work when elbowed by an undue number of onlookers, and their customary judgment and resourcefulness in emergencies may be seriously affected by the inescapable distractions associated with the entertainment of, and provision for, a large number of guests. This is the experience of every surgeon who has a conscience. It is true that a home team has an advantage over a visiting team, but even the home team, however steady under ordinary circumstances, is apt to pile up errors in a bad inning under the unusual stress of a championship series. And a surgical team is engaged in a far more responsible business than a ball-game.

It is with some such ideas in mind that the local committee has felt inclined to eliminate, so far as possible, as unsuited to a large assemblage, the more purely operative features which largely characterized the program of the original clinical congresses. With its avowed purpose of safeguarding the patient, the College cannot put its stamp of approval on a custom which may tempt some of its members either to rush through the preliminary studies of a newly admitted patient or, what is equally culpable, to hold over for the purposes of the meeting operations which might better have been done without delay. Furthermore, an objectionable degree of publicity has been a distinct evil of former meetings of the Congress. As a rule, the better the surgeon the more unassuming he is and the more he abhors seeing reference to his work in the lay press.

Certainly the College cannot wish to foster the mere spectacularization of surgery, so prevalent in days gone by, and the Boston members have decided to follow again the same course they pursued when the Congress met here before—the only course they can see whereby this tendency can in a measure be offset—namely, by a subsequent report, to be published in the official organ of this body, not only of the immediate but of the late results of all the public operations performed in the Boston hospitals before members of the College at this meeting.

There is no doubt but that one craftsman profits by seeing another craftsman at work, but if a few hundred artists should stand at the elbow of Mr. John Sargent while he is in the process of painting a portrait, it would in all likelihood so modify his customary performance that the sitter might with very good reason be dissatisfied with what may be spoken of in surgical parlance as the end-result. There is unquestionably a great deal of artistry about a well-conducted operation, but surely as surgeons we are not content to be mere manipulators and piece-workers—more interested in the technique than in the portrait. The important thing in surgery is not operative dexterity but what the patient looks like after you and I have removed our gloves, and what he is subsequently able to do with what we have left of him.

A good deal of this end-result discussion has emanated from the community in which we now meet, and not a little of it through

the expostulations of one person, who finally under the auspices of the College has undertaken, as a type-study, the investigation of the operative results of a single pathological lesion—the sarcomata of bone. It is not a question of how many legs or arms have been amputated for osteosarcomata, nor how many seconds it took to "drop the limb," a matter which chiefly interested our forebears, nor, indeed, by what particular method the operation was performed. The important questions are whether the amputation should have been done at all in view of the pathology of the lesion, and, granting an immediate recovery, whether the individual's expectation of life has been augmented. No doubt there have been, with all good intent, an unnecessary number of limbs sacrificed, just as there have been an unnecessary number of easily detached furnishings,—tubes, gall bladders, and appendices, tonsils, teeth, and turbinates,—piled on the altar of Æsculapius.

But let us settle, so far as we may, one thing at a time. And even this proves difficult enough. A clinical diagnosis of sarcoma of the tibia has been made, followed by amputation and a confirmatory pathological report on the nature of the lesion. The patient has survived for an unexpected number of years. No record of the case has been kept and the tissues have been discarded, even the histological preparations thrown aside. Does this long survival mean good surgery or an erroneous diagnosis? Was the tumor non-malignant in the beginning? Could the limb have been saved? These are questions difficult to answer, nor would a correct answer serve now to benefit this hypothetical patient. But tomorrow any one of us may be confronted by a similar problem in its relation to some patient of our own.

Only by the whole-hearted co-operation of a large body of surgeons, who have kept detailed and reliable records, can a reasonably exact answer be given to such a question as the operability of the various sarcomata of bone, and it is to secure this that the committee which has been at work on the subject has received the backing of the College. It unquestionably is something of a nuisance to each of us individually to interrupt our own personal investigations in other fields, long enough to add our small quota of percentages to what may seem time-worn problems that interest others more than ourselves, but there are many of these problems which can be solved only by the statistical study of a large mass of material, and it is well worth the trouble if someone is willing to take it, even if it saves only one occasional leg in the community.

My own feeling in the matter is that if the College wishes to lend its influence to studies of this sort it can best do so through the agency of the hospitals as an outgrowth and side-issue of its campaign of standardization. There could be no better way of gauging the working conditions in a given hospital than by the character of a report it would submit on some such question as, let us say, the results, immediate and remote, of the operations for cancer of the breast, covering a given decade. Such a report would reveal at a glance not only the quality of the operative work itself, but how carefully it was safeguarded—how correct were the diagnoses leading to the operation; how thorough the pathological studies; how dependable were the hospital case records; how conscientious the hospital in its quest for information concerning the ultimate results. If in each of the Class A hospitals some young member of the staff were given as his particular study for the year an analysis of all the cases of bone sarcoma recorded in the hospital files, and an effort were made to recall for re-examination, or at least to get reports from, all individuals still surviving, the information the College and its committee unselfishly desires in respect to this single problem could be easily obtained.

Every hospital, after its own method, has some sort of an annual publication, containing for the most part statistics and enumerations, of interest largely to administrators alone. These things are doubtless necessary for good housekeeping. But I would suggest that in place of the futile lists of diseases and operations which encumber these publications, the hospitals be requested to include each year a concise report upon some particular clinical problem to be selected by the Regents of the College. In this way ample data for almost

any required statistical study could be secured, and the process would lead to a very desirable regrouping of the institutions already on the acceptable list, into those which keep sufficiently reliable and complete records of their patients and those which do not. Let us hope that the College will take advantage of some such method of securing for analysis a mass of information such as that of which the committee now investigating the sarcomata of bone is in need. And when that has been obtained, let us turn to such other topics as can be illuminated in similar fashion through statistical studies, year after year.

I have been led to write this preamble concerning surgical end-results in general, the better to explain my reason for putting on record at this time some notes regarding a case which for three years masqueraded in the Brigham Hospital records as a melanotic sarcoma of the skull. I do so at the request of my persistent friend, Dr. E. A. Codman, though my inclinations would have led me to wait until I had learned something more about the condition by the opportunity of comparing it with other and similar lesions. It is true that this opportunity might never come. Though provisionally diagnosed as a melanotic bone sarcoma, probably metastatic, the case proves, from the evidence of time as well as from the evidence of subsequent histological studies, to be a tumor of less malignant nature than had originally been supposed. It is this, I believe, that Dr. Codman particularly wishes to have emphasized: namely, that a diagnosis of bone sarcoma in cases which have long survived operation must be received with skepticism until the original records of the case have been scrutinized anew with the greatest care. With this feeling I am fully in accord, and there is no question but that the following history is a good example of the diagnostic slips and pitfalls which surround all of us.

The patient (P.B.B.H. Surgical No. 10669), Mrs. C. was a woman of fifty-five years who was admitted to the Brigham Hospital June 28, 1916, because of a dome-shaped, bony prominence of the left parietal region which at first sight was regarded as the hyperostosis overlying a meningioma (dural endothelioma). Five years before her entrance she had bumped her head severely at this particular spot. The place remained sore and in the course of a year there slowly developed a slight prominence with some tenderness to pressure and a dull, uncomfortable ache. This swelling during the preceding few months had been enlarging somewhat more rapidly.

Apart from this bony tumor, her physical examination revealed no abnormalities. There were no localizing symptoms indicating any intracranial involvement, but the meningiomata not uncommonly fail to cause cerebral symptoms, even when these tumors reach a large size, and, what is more, the flat rather than the rounded types of these growths appear to be the ones which most often provoke some thickening of the overlying skull. The X-ray, however, did not tend to confirm the bedside diagnosis, for there was a well-outlined patch of rarefaction corresponding to the bony protrusion which was variously interpreted as due to a possible cholesteatoma, gumma, sarcoma, or bone-cyst.

At the operation a cranial flap was outlined, so as to give the involved area a generous margin, and on reflecting the flap a most unusual picture presented itself. Projecting within the skull were two fairly well-outlined prominent bosses of tumor as shown in the accompanying sketch—a tumor, moreover, of purplish-black color which had an appearance suggesting a melanoma. The dura was indented by, and was slightly adherent to the nodules, which were about a centimeter in height, firm as bone, and somewhat "thimbled" as to their surface.

Greatly distressed by this disclosure, I assumed that the growth must be the metastasis of a melanotic sarcoma, the original source of which had been overlooked. Accordingly for purposes of histological confirmation a small fragment was curetted out for immediate study. A report was returned that on crushing the tissue and examining the cells they were found to be both round and spindle-shaped, and to contain blackish-brown pigment in the form of fine granules—diagnosis, melanotic sarcoma. In view of this report it was presumable that there were corresponding metastases elsewhere, but nevertheless the exposed lesion was so definitely centered in the flap that the decision was made to sacrifice the bone, and on stripping it away from the scalp the external portion of the dark-colored tumor which adhered slightly to the pericranium (Fig. 2, frontispiece) was revealed. The growth proved to be about 3 centimeters in thickness.

The patient in the usual detail had been thoroughly examined before the operation, but subsequently she was again gone over from top to toe in order to see whether we might not possibly have somewhere overlooked a primary melanoma. Though nothing was found in skin or retina, I knew from a sorry experience that there nevertheless might be a primary focus hidden somewhere in the body.

The experience to which I refer was as follows. A young woman with symptoms of a parietal-lobe tumor was operated upon many years ago in the

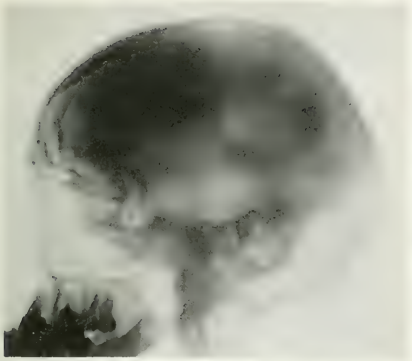

Fig. 3. Roentgenogram showing (poorly) the area of bone thinning in right parietal region at seat of the tumor.

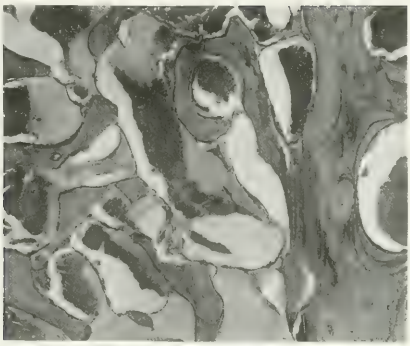

Fig. 4. Path. No. P.B.B.H. S-19-432. Histological appearance of the cavernous angioma (Mag. ×33).

Johns Hopkins Hospital, and a purplish-black growth the size of a hen's egg was encountered and easily enucleated. The histological examination showed it to be a melanotic sarcoma, and she was thoroughly re-examined for a possible primary source of origin without one being found. She made a perfect temporary recovery, but some months later because of a return of her cerebral symptoms she re-entered the hospital, to end her days there. A postmortem examination disclosed multiple cerebral metastases and a primary melanotic sarcoma in a small dermoid cyst of the left ovary.

But to return to the patient in question. She had an uneventful convalescence, accepted my explanation and apologies for having left such a large defect in her cranium, and was discharged July 1, 10 days after the operation. And now comes the part of the story which chiefly concerns our present topic.

The specimen was an unusual one. It was carefully described for the pathological records and the accompanying color sketch was made of it. Meanwhile the pathologist's report based on the fresh-tissue examination alone, had been forwarded to the record-room and the diagnosis of melanotic sarcoma was inscribed on the history. An index card in correspondence was made out for the files and the case soon forgotten.

The patient was not heard from for 2 years, when, in answer to the routine letter of inquiry which we are accustomed to send to all patients after that interval, she replied, contrary to expectation, that she was perfectly well and had dismissed from mind her old trouble.

This unexpectedly favorable report led to a re-examination of the specimen and a block was sawn from the tumor for decalcification and sectioning. It was in midsummer, there had been a change of technicians and a new pathological assistant. The specimen was side-tracked, appears never to have been sectioned, and the inquiry regarding the case again became submerged by a succession of other more pressing matters.

A year later, by now 3 years after the operation, enters the bone-sarcoma committee, and one of our house officers was asked to prepare for them the data they requested in regard to the Brigham Hospital series of cases. Mrs. C.'s case was included, and ere long, word was received from Dr. Codman expressing doubts regarding a three-year survival of a patient with a melanotic sarcoma of the skull. Whereupon we found to our humiliation that the diagnosis still remained based upon the original fresh-tissue examination. A new section was removed and decalcified, and the growth proves, in the opinion of Dr. S. B. Wolbach, to be a cavernous hæmangioma—a comparatively benign tumor (cf. Fig. 3).[1]

This, Gentlemen of the College, is my entire story. Its moral is obvious. Fortunately the error in our pathological diagnosis has made no vital difference to the patient, though I would greatly have preferred to have left her with less of a cranial defect, and I presume the growth might have been treated locally—possibly, indeed, by radiation. The lesson is that any one of us may at any time acquire an utterly erroneous impression regarding a pathological lesion and the effectiveness of our operative procedure in a given

[1] This appears to be a particularly rare lesion in the cranial bones. A case of similar nature was reported by George Schoene in 1905 in the Julius Arnold Festschrift, ("Ueber einen Fall von myelogenen Haemangiom des Os occipitale." Beitr. z. path. Anat. u. z. allg. Path. Jena, 1905, vii, supp., 688, 701

case. As a matter of fact, I understand that it is the experience of the Registry that at least two out of three cases recorded as sarcomata of bone prove in the opinion of the committee to be some other lesion.

Experience is the chief asset of a physician or surgeon, and possibly none is so valuable as that gained by our mistakes and errors of judgment. But knowledge to be exact must be based on something more than operating-room and bedside impressions. The only possible way to avoid the accumulation in our minds of inexact impressions regarding the results of our operative procedures for one condition or another is by a properly organized follow-up system which brings knowledge of the ultimate results not only to the hospital record-room, but vividly before us as individuals.

To be sure, I have illustrated these remarks by an isolated experience with a rare lesion, but we are just as prone to gain impressions which may be unjustified regarding our more routine performances. Though our bad results sometimes haunt us, patients who have suffered unnecessary or unsuccessful operations at our hands are likely to consult someone else and leave us in blissful ignorance of our failures unless we deliberately as individuals or as representatives of institutions set ourselves to pursue the maladies of our patients to their conclusion.

In this pursuit, moreover, we cannot effectively act alone, for we need to compare our results with those of other individuals or of other groups of individuals in other hospitals if we are to determine whether the best attainable results are being approximated in a series of operations for any given condition. In a co-operative study of this sort some sympathetic central agency like this College, which does not presume to act as a board of censors for individuals or hospitals, but which desires to improve not only the institutional conditions under which surgical operations are performed but to safeguard, as well, the character of these operations, can play a very important rôle.

EMBOLECTOMY IN THE TREATMENT OF CIRCULATORY DISTURBANCES IN THE EXTREMITIES[1]

By Dr. EINAR KEY, Stockholm, Sweden
Director and Surgeon-in-Chief, Maria Hospital

ONE of the most satisfactory operations that can be performed is the removal of an embolus by means of arteriotomy (embolectomy) in suitable cases. This has been made possible through the development of the technique in operations on the vessels of the body. Such a branch of surgery is consequently quite in its infancy, and the operations connected with it are not numerous. But more cases have occurred for operation during the last year, and the results of the operations have substantially improved. In order to establish the indications for embolectomy and to improve the technique at these operations, further experience is required, and every fresh observation is of great interest.

The first to try to remove an embolus by arteriotomy was Suabanejew (1895). Because of threatened gangrene in one leg as a result of an embolus, he performed arteriotomy upon the femoral artery (arteria femoralis) to remove the embolus. This was not successful; after amputation of the leg, the patient succumbed.

During the first decade of this century, several surgeons tried in vain to remove an embolus, or an arterial thrombus, by arteriotomy to restore the circulation and to prevent the development of gangrene. As one among the first to attempt this, the name of Francis Stewart must be mentioned. Also I wish to call to mind the interesting case operated upon by Murphy in 1908. The first completely successful embolectomy was performed in 1911 by Labey, who removed an embolus from the arteria femoralis communis,[2] 6 hours after its appearance. The second entirely successful case of embolectomy was carried out by me the year after. In my case also the embolus was in the arteria femoralis communis, and the operation was undertaken 6 hours after its appearance.

Since then, more and more cases have come for operation. I myself have had occasion to remove by arteriotomy an embolus that was producing circulatory disturbance in the extremities, 10 times on 9 patients (one had embolus in both legs). In these cases the emboli were located twice in the arteria femoralis communis, twice in both arteriæ femorales communes and arteria poplitea in the same leg, once in arteria femoralis communis and the arteria femoralis propria in one leg and in the arteria poplitea in the other, once in only the arteria poplitea, once in the bifurcation of the aorta and the arteria femoralis communis, once in the arteria axillaris and arteria brachialis, and once it was probably located in arteria iliaca with secondary thrombus formation extending into the arteria femoralis. In my cases, the operation was performed from 2 hours to 4 days after the earliest symptoms. Gangrene appeared after four of the operations. In the other cases, the result was good. Of the cases in which gangrene occurred, one was operated upon 4 hours after the first symptoms appeared, two after 15 and 43 hours respectively, and one not until the fourth day.

For the sake of comparison, I have been able, in addition to my own cases, to collect 51 cases from the literature and also cases operated upon by Swedish surgeons. In no instance has operation been fully successful when it has been done more than 24 hours after. In the accompanying table, I have grouped together cases that were operated upon within the 24 hours.

LOCALIZATION

An embolus will lodge most readily where a vessel divides. In the largest number of cases coming to operation, the embolus has been located in the dividing part of certain

[2] In this paper the term arteria femoralis communis indicates that part of the artery from the arteria iliaca externa from which the arteria femoralis profunda comes off from the arteria femoralis, and from this point to the arteria poplitea it is regarded as the arteria femoralis propria.

[1] From the Maria Hospital, Surgical Department, Stockholm, Sweden; read before the Clinical Congress of American College of Surgeons, Boston, October 23–26, 1922.

RESULT OF THE OPERATIONS PERFORMED WITHIN TWENTY-FOUR HOURS

[illegible]	[illegible]				Gangrene				[illegible] after operation			
	Time	Operator	Age of patient	Locality of embolus	Time	Operator	Age of patient	Locality of embolus	Time	Operator	Age of patient	Locality of embolus
[illegible]	[illegible]	Michaelsson	[illegible]	Art. femoralis								
	[illegible]	Key, Case IV	[illegible]	Art. femoralis	[illegible]	Borchgrevink	[illegible]	Art. femoralis*				
	[illegible]	Bauer	[illegible]	Bifurcatio aortæ								
	[illegible]	Franzén	[illegible]	Art. brachialis								
	[illegible]	Key, Case III	[illegible]	Art. femoralis and poplitea	[illegible]	Lindström	[illegible]	Art. poplitea				
	[illegible]	Key, Case X	[illegible]	Art. axillaris and brachialis	[illegible]	Key, Case IX	[illegible]	Art. femoralis*				
	[illegible]	Pupovac	[illegible]	Art. femoralis								
[illegible]	[illegible]	[illegible]	[illegible]	Art. femoralis					[illegible]	Pallin	[illegible]	Art. femoralis
									[illegible]	Rodén, Case V	[illegible]	Art. femoralis and bifurcatio aortæ.
	[illegible]	Key, Case I	[illegible]	Art. femoralis					[illegible]	[illegible]	[illegible]	Art. femoralis.
									[illegible]	Platon	[illegible]	Art. poplitea.
	[illegible]	Key, Case II		Art. poplitea								
	[illegible]	[illegible]	[illegible]	Art. axillaris								
[illegible]	[illegible]	[illegible]	[illegible]	Art. femoralis	[illegible]	Rodén, Case IV	[illegible]	Art. femoralis*	[illegible]	[illegible]	[illegible]	Bifurcatio aortæ
	[illegible]	[illegible]	[illegible]	Art. axillaris	[illegible]	Sjövall	[illegible]	Bifurcatio aortæ*	[illegible]	[illegible]	[illegible]	Art. femoralis
					[illegible]	Matti	[illegible]	Art. femoralis*				
					[illegible]	Key, Case VI	[illegible]	Art. femoralis et poplitea*				
[illegible]	[illegible]	[illegible]	[illegible]	Art. femoralis	[illegible]	Wideröe, Case III	[illegible]	Art. femoralis				
					[illegible]	Wideröe, Case II	[illegible]	Art. femoralis*				
					[illegible]	Rodén, Case IV	[illegible]	Art. femoralis*				
[illegible]	[illegible]	Key, Case VIII	[illegible]	Bifurcatio aortæ and art. femoralis	[illegible]	[illegible]		Bifurcatio aortæ	[illegible]	Michaelsson, Case I	[illegible]	Bifurcatio aortæ
	[illegible]	[illegible], Case II	[illegible]	Art. poplitea	[illegible]	Petren	[illegible]	Art. femoralis communis*	[illegible]	[illegible], Case II	[illegible]	Art. poplitea.

* [illegible]

large vessels, such as bifurcatio aortae, parts of arteria iliaca communis, femoralis communis, poplitea and also in arteria axillaris where arteria subscapularis branches off. In some cases, the embolus which made necessary an operation had been preceded by other emboli which were so located that operation was not indicated. Sometimes after the operation, fresh emboli may appear. It is important to recognize that not infrequently two or more emboli indicating operation may occur in different parts. Such emboli may be located either in the chief artery of the same extremity or in another.

If an embolus is not removed, in time it generally goes through a stage of secondary thrombus building. As a result of this, an embolus which at first does not fully close the lumen, may become an obstruction. The embolus grows chiefly and most easily toward the periphery, but it may grow to a certain extent in a centripetal direction. Secondary thrombus building partially or totally impedes the collateral circulation, and in this way the danger of gangrene increases. The danger is also frequently augmented when the embolus appears in run-down individuals with weak heart action, which renders collateral circulation more difficult. Experience teaches that when an embolus is located at the division of the aorta, of the arteria iliaca communis, the arteria femoralis communis, the arteria poplitea, the arteria axillaris, and sometimes in the upper part of arteria brachialis, the danger of gangrene in the extremities is more or less grave.

The time for the appearance of secondary thrombus formation varies considerably. The danger of it generally increases with the time that elapses after an embolus has appeared. I have seen the beginning of a secondary thrombus formation as early as 2 hours after the appearance of an embolus. Sometimes, in late operation, it does not appear at all. Secondary thrombus formation renders operation more difficult and prognosis less favorable.

In cases which come early for treatment, it is generally easy to distinguish at the operation between the original embolus and the secondary thrombus; in later cases this may be difficult or impossible. Thus it may also be difficult or impossible in some cases to determine where the primary embolus was located.

SYMPTOMS

The symptoms may set in either suddenly, which is most usual, or more slowly and stealthily. In the former case, the embolus is so large that it causes serious disturbance to the circulation. In the latter case it obstructs only a part of the lumen in its first stage. Later, by the growth of secondary thrombus, or by the appearance of a new embolus, the lumen may become blocked, and the circulatory disturbances will consequently increase. In the former case the danger of gangrene is greater than in the latter when the collateral circulation has more time to become established. The degree of circulatory disturbance caused by the presence of an embolus depends upon whether it fully obstructs, upon the development of the collateral circulation, on the condition of the walls of the vessels, and on the action of the heart. Consequently, the intensity and extent of the circulatory disturbance differ considerably in different cases, from quite mild cases without danger of gangrene, to threatening gangrene of varying extent.

The symptoms that characterize an embolus are partly *subjective, partly objective. The subjective symptoms are:* pain, a sensation of cold, and disturbance of the sensibility. *The objective symptoms* are: change in color of the skin, lowering of temperature, disturbed motility, absence of skin and tendon reflexes, absence of pulsation.

The pain most often sets in suddenly, and this is highly significant. At the same time, the patient experiences a *sensation of cold and numbness* in the extremity affected. *The sensory disturbances* vary from a partial to a complete suspension of sensory function. The boundary of complete suspension is not often sharply defined, but the transition to partial suspension may be clearly observed.

Change of color. The suspension of circulation results in marked anæmia of the affected extremities, the temperature lowers, and the skin becomes deadly pale and possibly somewhat cyanotic Discoloration may be seen in livid to dark blue patches. The time when

these patches appear varies in different cases. As one would expect, anæmia and low temperature are most pronounced toward the periphery. A prick from a needle causes no bleeding. Motility is suspended or restricted in proportion to the degree of circulatory disturbance. The sensory disturbances, the change in color of the skin, and the part of the extremity that feels cold do not always fall quite within the same boundary, neither do they always quite correspond to those parts where the motility has been affected. The motility at least may apparently remain for some time in a part of the extremity which is cold and in which the sensory functions are suspended or impaired. The pulse below an embolus generally ceases. By palpation one can sometimes feel an embolus like a string in the painful part. The possibility of palpating an embolus depends upon its locality and on the corpulence of the patient. The emboli easy of access for palpation are those situated in the arteria femoralis communis, the upper part of the arteria femoralis propria and the lower part of the arteria axillaris and brachialis. It would be unusual to be able to palpate an embolus in the arteriæ iliacæ.

As the collaterals take over a part of the circulation, the limits of the region threatened with gangrene will be situated at a longer or shorter distance peripheral to the seat of the embolus, and they are not at first so sharply defined. The extent of the sphere threatened with gangrene by the situation of an embolus varies in different cases, as has been said, according to the development of the collaterals, the size of the embolus, the heart action, and also upon the stage reached by the secondary thrombus formation. Likewise, the symptoms of circulatory disturbance can diminish or disappear should an embolus situated in a position conducive to it again become detached and lodge more peripheral. If from being not quite obstructive, an embolus becomes so through secondary thrombus formation or through blocking up the collaterals, naturally the symptoms increase.

Some cases have precursory symptoms, probably depending upon a small embolus. In other cases, pronounced symptoms in another locality have preceded an embolus. It would take too long to go into the symptomatology of the various seats of an embolus.

DIAGNOSIS

The symptoms of an obstructing embolus appearing suddenly in the large vessel of the extremities, are so marked that the diagnosis is seldom difficult (sudden severe pain in the extremity, a feeling of cold and numbness, sensory and motor disturbance, and disturbance of the circulation). When the embolus is not entirely obstructive to begin with, but becomes so gradually by augmentation, the symptoms are often not so pronounced at first, and the diagnosis may be difficult.

With regard to differential diagnosis, it is of utmost importance to distinguish between an embolus and a *thrombus in the artery* due to arteritis. Indications of an embolus are a sudden onset of symptoms, and the fact that the patient has organic disease of the heart or the existence of an active predisposition to thrombus building as a result of an infectious illness or of an operation. The origin of an embolus, however, cannot always be pointed out. Often these patients have had or have circulatory decompensation. The signs of an embolus go far wider than its aforementioned symptoms. When the symptoms do not set in so quickly, the differential diagnosis is more difficult. In the case of an arterial thrombus, the patient has often had precursory symptoms for a long time, even for years—sensation of cold and numbness, neuralgic or rheumatic pain in the extremity, and circulatory disturbance with cyanosis in the peripheral parts of the extremity. Further, it must, of course, be taken into consideration whether arteriosclerosis be present. It is true, the proof of arteriosclerosis is not decisive and does not preclude embolus. Mistakes have occurred in distinguishing between a developing thrombus and an embolus. With a thrombus in the vein, the extremity is warm, cyanotic, swollen; as a rule the pulse is perceptible and the sensibility unchanged; and usually the thrombosing vein feels distressingly tender. With an embolus, the extremity is cold, generally pale, the sensibility is partially or completely suspended, and the pulse is imperceptible or very weak.

The thrombosing part can sometimes be palpated. When a thrombus originates before an embolus, the latter may be easily overlooked.

Local traumatic arterial thrombus. After trauma with slight internal injury, when the wall of the vessel is not ruptured, an arterial thrombus may appear in the injured place. As a rule, differential diagnosis in such a case is formed from the anamnesis.

With regard to an aortic embolus, a mistake might be made between hæmatomyelia and acute myelitis. One of my cases was sent to the hospital under the diagnosis, embolus medullæ spinalis. Embolus is characterized by pallor and cold about the legs as well as imperceptible or weak pulse.

LOCALIZATION

Many difficulties may be encountered in localizing a thrombus. As has already been shown, because of the collateral circulation, the circulatory disturbance will appear peripheral and only at a distance, greater or less, from the embolus. In many cases, therefore, it has been concluded that the embolus is seated still more peripheral. By taking into consideration that an embolus generally lodges at the division of an artery, and that it is seated more or less central to the boundary of the circulatory disturbance, and also by carefully observing where the pulse ceases or decreases in strength in the artery in question, one can generally succeed in localizing it. When observing the pulse, one must take into consideration that it may be difficult to detect it because of the patient's weak heart action.

INJURY TO THE INTIMA WITH CONSEQUENT THROMBUS BUILDING

After an embolus has been removed, a lesion of the intima in the part where an embolus has been situated, is likely to take place sooner or later which may cause fresh thrombus formation so that the vessel may become obstructed, and removal of the embolus will bring no benefit. There is no doubt that it would be difficult, if not impossible, to decide in any one case whether thrombus building arising after removal of an embolus is caused by a lesion of the intima or is the result of some mistake in technique. Even though the risk of the lesion, with its consequent tendency to thrombus building, increases with time from the outset of the embolus, yet the increase of the risk is not in direct proportion to the length of time;—but wide variations and peculiar exceptions are to be found, just as in secondary thrombus building.

Naturally, of great interest and practical importance is the question how long the blood stream through the chief arteries to an extremity can be suspended by an embolus without injuring the vitality of the tissue. As yet it is not known with exactitude how long the blood stream to an extremity can be obstructed without loss of vitality in the tissue. It is of general knowledge that, if one must bandage an extremity to stop hæmorrhage, for example with an Esmarch's bandage, one must not let it remain too long, or ischæmic contraction will take place; or, if the bandaging remains still longer, gangrene will appear. It is stated that ischæmic contraction may arise when the bandaging has lasted from 2 to 3 hours. In the matter of an embolus, the conditions are quite different. Here the arterial circulation is eventually suspended while the vein and lymph channels are not obstructed. Nor are the nerves exposed to pressure. Further, the embolus may happen not to be fully obturating until it becomes so by a secondary growth, so that the time when the symptoms set in, and the time of complete suspension of the flow of blood through the arteries do not coincide. In the case of an embolus, the collateral channels also play a part more or less, and the heart action and condition of the vessel walls are of considerable importance for the functioning of these. The patient's general condition and the vitality of the tissue (the patient's age) likewise play their part.

After the removal of the chief embolus, small emboli that have previously lodged further out in the peripheral arteries may hamper the circulation. Secondary thrombus building may obstruct important collateral channels, and in this way make the obstruction of circulation more complete than before the removal of the embolus. After its removal, if the thrombus formation has not also been completely taken away, more or less circula-

tory disturbance will be caused. Thus there are many factors which contribute to the result. No set time before gangrene occurs can be given; one must be prepared for great individual differences. The longest time that has passed between the appearance of the symptoms and embolectomy, without ischæmic necrosis or gangrene setting in, was 24 hours. Probably the circulation was not completely obstructed so long as that.

ANÆSTHETICS

In all my cases I have used local anæsthetics with novocaine and adrenalin solution, all of which received a complete and satisfactory anæsthesia. As these operations have to do with individuals of low physical tone, and generally of poor heart action, it is most important that the operation be carried through as carefully as possible. The risk of the operation is, no doubt, considerably less if it can be done with local anæsthetic. When operating on the relatively an easily accessible vessel, such as the arteria axillaris, brachialis, iliaca externa, femoralis or poplitea, one generally ought to manage with local anæsthetic. If, for the removal of an embolus in the aorta, or in the arteria iliaca communis, one must perform laparotomy, it will as a rule be necessary to use a narcotic.

TECHNIQUE

When performing embolectomy, it is of highest importance that the proper technique be used. The slightest mistake might cause thrombosing of the sutures, by which the good result of the operation might be lost.

As the technique for the suturing of vessels is nowadays well known, I shall not give an account of it. I myself have used Carrel's technique mostly, using very fine needles and very fine silk sterilized in vaseline. In my first cases, I covered the wound with vaseline compresses. When proceeding thus, the rubber gloves used during the operation become very slippery, which renders the sewing with fine needles considerably more difficult. On account of this, I have made a slight change in the technique since 1919. As sodium citrate prevents the blood coagulating, I have replaced the vaseline compresses with compresses dipped in 2 per cent solution of sodium citrate. The arteries have been surrounded with the same and the surface of wound covered with it. From the time when the vessel is opened, until the completion of the suturing, instruments and gloves are rinsed in 2 per cent sodium citrate solution. I consider this method of procedure good practice, and am well satisfied with it. The curettes or probes that are used for removing the embolus should be smeared with vaseline.

When the artery is laid bare, the operator satisfies himself of the position of the embolus and its extension above and below. Should it be uncovered in the wrong place—and the error of calculating lower down than the embolus often occurs—he has either to follow the artery until meeting with the embolus, or to expose it in another place. If, as is usually the case, the embolus has lodged at the division of an artery, he carefully attempts to isolate the vessel where it divides so that clamps may be put upon branches also. Should other branches of the artery lead from the area in which the embolus is situated, the most prudent method is to isolate these vessels as well, in so far as the vessel clamps can be used. When the artery has been surrounded with compresses dipped in sodium citrate solution, a weak vessel-clip is placed central to the embolus. Since the intima where the embolus is situated may easily become injured by it, and since it is best to perform arteriotomy upon an uninjured intima, one ought, if possible, to avoid arteriotomy at the place where the embolus is lodged, and to do it immediately above the embolus. If difficult or impossible to get sufficient room above the embolus, one may be obliged to incise the blood vessel at the part where it is situated. Sometimes it is better to incise below it. When the arteriotomy has taken place, the embolus may happen to fall away of itself or by a slight pressure on the vessel. Generally it must be lifted out, and this should be done exceedingly cautiously, with a fine pincette or a small blunt curette, in order that the intima may not be injured. At times the embolus is so fragile that it goes to pieces when taken hold of and has to be removed in many parts. When the embolus is long, or secondary

thrombus building is present, it may be difficult, or impossible, entirely to clear the vessel. It is of utmost importance that this be done as completely as possible. Should one not succeed in removing the central parts of the embolus or secondary thrombus, or when the embolus is of such a length that it cannot be extracted otherwise, one may, through an arteriotomy opening made below the locality, and with a blunt curette or with a sound, attempt to loosen the same and let the flow of blood wash away the pieces of the thrombus. It will sometimes be necessary to proceed in this way with an embolus in the upper part of the arteria axillaris and in the arteria subclavia.

The distal part of the iliaca externa can be easily exposed extraperitoneally under local anæsthesia. The inner part will be more difficult, particularly with stout persons. The arteria iliaca communis and bifurcatio aortæ are exposed most easily by laparotomy. This operation, which must generally be performed with a general anæsthetic, is nevertheless a great strain on these patients, who are mostly of poor physical tone. It is far less trying for them if one loosens the embolus with a blunt curette introduced through an incision in the arteria femoralis communis, and lets the flow of blood rinse it out. That an embolus in the bifurcatio aortæ can be advantageously removed in this way has been shown in one of my own cases. Suppose, however, an embolus be situated where the aorta divides, then the other side of the arteria femoralis communis ought to be exposed first and a vessel clamp placed here, so that the pieces of the embolus which are loosened and possibly flung out to this side may be stopped against the vessel clamp and easily taken out afterward. In a case of mine, a small embolus had lodged in the arteria femoralis communis division in the other leg, and was not discovered until the day after the operation. In order to attempt the removal of an embolus from the bifurcatio aortæ with retrograde probing, it would probably be necessary to do it from both sides. When possible to lay bare the part of the artery where the embolus is located and remove it straightway, this is clearly the most expedient method; but, with an embolus in the arteria iliaca communis or bifurcatio aortæ, such an operation is so severe that I consider the procedure I used in my own case, with the modifications I have here suggested, to be preferable as a rule.

After the embolus and possibly secondary peripheral thrombi are removed, vessel clamps should be placed so that the bleeding of the collaterals may not impede the sewing up of the wound in the vessel wall. These clamps should be placed peripherally to the arteriotomy opening, and on the vessel channels that lead from the opening; that is to say, between the part of the chief artery where the central and the peripheral vessel clamps have already been placed. As secondary thrombus building may arise centrally to an embolus, one should take off the central vessel clamps for a moment or two before sewing the vessel wall together. Thus any centrally placed thrombus, or remains of the embolus, can be flushed out by the stream of blood. During this flushing-out process, the peripheral vessel clamps must be in place, so that any possible parts of the embolus or the central thrombus may not flush into the peripheral parts of the vessel. When the embolus has been removed, the blood should be allowed to spurt out through the arteriotomy opening in a vigorous stream by intermittent jerks that synchronize with the pulse. Should the blood run only from the central end, we have an indication that the passage is not quite clear and that there is some obstacle above. This obstacle then must be cleared away, either by retrograde probing, or by laying the vessel bare higher up and making a fresh arteriotomy. Thrombi left in the peripheral arteries will cause circulatory disturbance more or less severe according to their extent.

As already stated, the embolus is often repeated, and two or more emboli within the chief artery frequently occur in the same extremity. It is therefore most important to direct special attention during the operation to the possibility of manifold emboli within the chief artery. If such be overlooked, the circulation will not be fully restored, and gangrene may set in. *After the embolus and the contingent secondary thrombus are removed and the vessel has been sewn together, investiga-*

tion must be made as to whether the circulation has been completely restored in the extremity. Should circulation not be restored, an examination must be made to discover whether more emboli are present, and according to the diagnosis thereupon, these also must be removed if possible.

Attempts have been made also by a bloodless method to remove the impediment in the circulation that an embolus gives rise to, by means of crushing it with massage. Some successful cases of this method have been described in literature. It is certainly not entirely a safe procedure to loosen an embolus by massage, as it might lodge in a fresh place and cause gangrene. This method ought to be wholly confined to cases of embolus, with threatening gangrene where arteriotomy is contra-indicated because of severe arteriosclerosis, weak heart action, or low physical condition, or where arteriotomy cannot be done because of local circumstances.

The prognosis for the possibility of preventing by embolectomy the occurrence of gangrene in connection with an embolus in the bifurcatio aortæ, the arteria iliaca communis, or in the chief artery of an extremity, depends very largely upon how soon after the appearance of the embolus the operation takes place. The sooner the operation, the better the prognosis. If, after considering the patient's general condition, the action of the heart and the condition of the vessel, an operation is indicated, then the prognosis for it during the first 10 hours is quite favorable, but will become less favorable very quickly after this period. Even when gangrene has begun to appear, a vessel may become permeable after embolectomy, and the condition of the circulation improve, with the result that the line of demarcation moves further peripherally.

END-RESULTS

In most cases, embolectomy has been performed on patients with some degree of organic heart disease. These patients may go through the operation, yet the origin of the trouble still remains, and they generally succumb to it sooner or later. Nevertheless, many have had relatively good health for a number of years, and could work more or less. Naturally the prospects of a lasting benefit are better in the cases where there has been no previous organic heart disease, but where the embolus appeared from another cause, as infection.

INDICATIONS

An embolus, which causes circulatory disturbance of a threatening character in the upper or lower extremities ought to be removed by arteriotomy unless there are contra-indications otherwise present. Moreover, the operation ought to take place as soon as possible. The localities chiefly affected in such cases are: bifurcatio aortæ, arteria femoralis communis, arteria iliaca communis, arteria poplitea, arteria axillaris and the upper part of arteria brachialis. Partly to avoid the risk of secondary thrombus building and partly not to incur a risk of injury to the intima, embolectomy ought, in my opinion, to come into consideration at an early stage, before the embolus in any of the above-named localities has produced threatening circulatory disturbance; so soon, indeed, as the symptoms are sufficiently clear for the diagnosis to be formed, and threatening symptoms need not be expected.

If gangrene has already begun to appear it may, in certain cases, be indicated that, through attempting to improve the circulation by embolectomy, the line of demarcation may move further peripherally, and thus a smaller section will require amputation.

As the embolus suitable for operation is far from rare, it is of moment that practising medical men learn to diagnose it in time, and that they immediately consult a surgeon or send the case to the surgical department of a hospital.

If, on account, of local circumstances, this cannot be done, or if the operation be contra-indicated because of the patient's general condition, the action of the heart, or the condition of the vessel, an attempt should be made in an early and suitable case, to crush the embolus by massage.

JOHN B. MURPHY ON SURGERY OF THE JOINTS[1]

By RAFFAELE BASTIANELLI, M.D., F.R.C.S.(Hon.), Rome, Italy

WHEN the Director General of the American College of Surgeons, in the name of the Board of Regents invited me two years ago to deliver the Murphy oration, I was obliged, much to my regret, to decline, on account of a previous engagement, and when the invitation was kindly repeated for this year I accepted it with pleasure, because I felt that through this great honor conferred not to my person but to my country even my humble voice could contribute to show the appreciation we have in Italy for American surgery and for the teachings of John B. Murphy.

In the course of time I realized how big a task I had undertaken and in thanking the Board of Regents, the Honorable President, and the Director General, I wish to express to all my deep gratitude for this invitation and my feelings of indebtedness to America, since from this country I have received many of the best impulses which can enhance a man's life.

I first heard of Dr. John B. Murphy when I read his contribution on the button devised by him. Soon afterward I had the pleasure of meeting him in Rome, at the International Congress of Medicine held in 1894. I remember him as a tall man, dressed in a long black frock, walking quickly through halls and corridors demonstrating this button. He carried with him rubber tubes in which skilfully and quickly he inserted it, and while pulling them apart and showing the firm reunion, he would conclude . . . "now your stomach and bowels are buttoned for good" and quickly disappear for the next demonstration.

He was accompanied by his beautiful and distinguished wife, of whom, on later occasions, I learned the high qualities and the importance that she had had in his career and in his welfare.

I will repeat only one episode he told me, that one night he, being extremely tired by the great daily work and not feeling well, was asked urgently to go and see a very severe case at a distance of some two hundred miles, and when Mrs. Murphy saw that his conscience was debating in the conflict between duty and the tired body, she ran to the telephone and asked for information. When she was told how desperate was the man's condition, so that Dr. Murphy's visit would be practically of no use, she offered to go herself instead of the doctor, saying to the astonished people: "Let me come, I will try to help you in his place." And she went and she found the man expiring, and she took care of the children, of the mourning wife, and of the burial, and when she left the house the family felt her help as true and as good as coming from a messenger sent by God. To such a woman I wish to offer my most deep remembrance and honor.

I have seen many times Dr. Murphy in his work and in his clinics and every time I could find a new progress of his mind and of his hands, and leaving him I felt as if his enthusiasm and his originality were permeating my mind, accompanying me, and working deeply on me as a spiritual provision long to last. Such was the influence of his strong personality as a surgeon and as a teacher. Of him spoke so well Sir Berkeley Moynihan, and I consider his oration such a just tribute to the man that it is unnecessary for me to speak further of his person.

The button made him famous in his youth and justly, for it gave a great impetus to intestinal surgery and even now though a good surgeon can rely upon infallible sutures, still it maintains favor among some. If it is just to say that for the majority of surgeons the button is a historical remembrance, it is equally just to say that the man who originated it rose higher and higher, for his judgment was above his work, and he could continually improve it, since he brought to it the scientific spirit and the broad conception which can make of a surgeon an artist, that is the man who creates, and not a mere artisan.

If we can say that when he was attacking a problem he did it always with a full scientific

[1] The third John B. Murphy Oration in Surgery, delivered before the Clinical Congress of American College of Surgeons, Boston, October 22, 1923.

and clinical preparation, we must say that for none did he do this so perfectly as for that of the bones and joints, and I believe that in none of the many questions with which his name is connected he has left such a deep and everlasting mark as in this, for what he taught then is almost exactly what we believe now, a very rare event in those quick days.

His investigations began in 1901 and in this year he performed his first arthroplastic operation. In the following year he gave a preliminary report and a demonstration of a case. From that time on, he constantly worked on this subject, as it appears from his publications, so that we may well say that he dedicated to it the last 15 years of his life.

If his main contribution in the surgery of joints is the treatment of ankylosis, I believe that it is no less worthy of merit that he developed a rational method of treatment to prevent ankylosis. Time and especially the late war have shown the good foundation on which his principles of treatment were laid, and while not all of the principles were original with him, nobody before the war so clearly and so forcibly impressed them upon the minds of the surgeons.

Do practitioners realize the great importance of such principles? If we were asked what is the ultimate fate of an articular infection, almost every one would answer that the result is the loss of function, if life and limb are not destroyed. We must fight this opinion most strenuously, as the surgeon who believes thus is like the general who believes he will lose the battle. Let us say instead that the aim of treating lesions of joints is to preserve function and if certain rules are followed it is possible to do this in a great many more instances than is believed generally.

How deeply John B. Murphy was impressed with this fact is shown by the attention he repeatedly paid to this argument in his lectures and by his efforts to develop this theory not only along practical but scientific lines. He believed that inflammations of the joints were of metastatic origin, and that especially the so-called rheumatic affections originated as a rule from a primary infection of a mucous membrane. He tried to establish the exact time of occurrence of the metastases for each kind of infection. In this way better than by reasoning, he could help to show that trauma, chills, wet weather, etc., were only occasional causes of arthritis. Every one will agree with him on these points, even though they do not agree with him as to the ability to determine the exact time of incidence of the metastasis.

The anatomical and physiological conditions present in a joint when infection develops have been clearly described by him, and he was able to show by practical demonstration that distention of the synovial membrane by exudation must be promptly relieved, since early absorption and self-defense of the joint are seldom possible. He stressed the opinion that opening or draining a joint was very dangerous, while puncture, aspiration, and formolglycerin injections would be productive of favorable results as far as function is concerned. And this was the lesson that the war taught us later. We all agree now how dangerous it is to keep open, to drain, and especially to plug a joint. We agree that even bad wounds can be cured with very good functional results if the surface infection is dealt with by extensive removal of all the tissues involved by the lesion and if the joint is hermetically sealed by suture. At the present time, however, we may not hope to master the infection in every case, especially when it assumes the severe form of capsulosynovial phlegmon, for in such cases the question of preservation of life and limb generally arises and radical measures must be instituted.

The next important principle he insisted upon was not only the well-accepted one to prevent bad position of the joint, but also to avoid immobilization as a routine. Murphy was a warm upholder of this principle. He believed that muscular contraction was one of the most active factors in producing ankylosis as through such contraction the bone ends were pressed together and destroyed. This sequela can be avoided only by permanent traction. In that he was a follower of the great principle which originated in America. The damage produced by immobilization itself is worthy of great consideration; in

fact I feel that we are about to swing to the opposite point of view—that articular lesions should not be treated by immobilization even tuberculous lesions, although there are naturally exceptions. How revolutionary this is from the old teachings of Bonnet so long followed religiously all the world through! It seemed impossible at the beginning of the war to conceive that purulent arthritis could be treated by small openings, and by active mobilization, but now clinical experience has shown that mobilization according to Willems has stood the test of time.

There is much to be hoped for in the antiseptic treatment of joint infections by means of the new deep germicidal substances, for instance the derivatives from quinine and from aniline dyes.

Autogenous vaccine therapy also holds a prominent place in joint treatment according to Murphy. Today we are far from believing in a specific action produced by such therapy, and the tendency is growing toward the principle that the results obtained are due to the reaction of the body tissues to a non-specific stimulus. We are coming back to the old venerable tradition of nature-healing efforts.

The doctrine of healing inflammation and of the healing fever has had no greater exponent than Professor Bier, whose teleological principles applied to the treatment of acute or chronic infections are worthy of much consideration. However, his treatment with passive hyperæmia has not found favor among the practitioners, owing especially to technical difficulties, and so it has disappeared except in a few German clinics. Some 20 years ago he proposed the injection of foreign blood in treating gonorrhœal arthritis, as he wanted to activate the healing tendencies of the body through a general stimulus given by a foreign protein. According to his views and to the ones lately developed by others, we have come to believe that all the remedies at our disposition work in the same way—that is, they increase the power of healing inflammation. It does not make much difference in principle if these remedies are vaccines, specific or nonspecific, or protein substances, or antiseptics, or physical agents. We may call this therapy proteintherapy, or since the same results have been obtained with inorganic chemical products, we may call it activation of the protoplasm as suggested by Weichardt, or we may call it as does Zimmer, the threshold stimulus therapy (*Schwellenreiz Therapie*).

Leaving aside the theoretical problems involved in such a question, one thing is certain and that is that these substances produce in the tissues a destruction of cellular elements and their products made free produce an increase in the cellular activity against the disease. You are all familiar with the researches made in this country and in Germany on this subject and with the results obtained. You have heard of the remedies they call sanathrit, kasein, and yatren kasein. The last according to Zimmer is giving the best results as it is easy to administer. He claims to have cured promptly gonorrhœal arthritis, acute shoulder arthritis, chronic arthritis, arthritis deformans, rheumatic pains, and neuralgia. Let us hope that such a miraculous therapy is a real one.

Whatever we may do, however, ankylosis will never be completely eliminated. To the treatment of ankylosis John B. Murphy gave the greatest impetus and his views, although having had some few predecessors, can be justly called his own.

The idea of restoring movement to a stiff joint by a cutting operation was not a new one. J. Rhea Barton, of Philadelphia, in 1826 performed the first osteotomy through the great trochanter to obtain a pseudarthrosis and mobility of the hip joint which was in a very bad position. It is very interesting and almost pathetic to read of his plans and his hopes. "I do believe," he says, "that nature would not possibly witness my labors to effect what she has so often herself endeavored, unaided by art, to establish, but that she would be ready to co-operate with me in the formation of a new and useful joint, as a substitute for the one which disease has annihilated." But nature did not answer this invocation and after a few years the joint was ankylosed. He planned also to extend the use of osteotomy to the knee, shoulder, elbow (for which he sketched an angular resection), to the big toe, and to the jaw, "performing the operation through the

original point or so near to it that the use of most of the tendons and muscles would not be lost, and where the deformity or inconvenience was such as would induce the patient to endure the pain and incur the risk of an operation."

Could we express in better words today the indications for arthroplasty? It was not a new idea that the interposition of tissue between two bone ends could produce a pseudarthrosis. It would be easy but long and tedious to present to you the historical development of the question. I will say only this, that notwithstanding that principles were known and some operations had been performed they were rather attempts, and when Murphy entered this field of endeavor the profession was very loath to accept his theory that the real treatment of ankylosis, even if the parts were in good position, should be mobilization. Murphy looked at the problem from a general viewpoint, studied it experimentally, and gave the details for properly performing the operation upon every joint. He also introduced a new theory that the fat and fascial flap would be changed by articular function into a kind of hygroma and would form the articular space. The profession accepted his teaching but slowly and only recently has it been possible to study the results obtained by some few men who entered the field, as Baer in this country; Putti in Italy; Payr, Hoffa, Bier, and others in Germany.

The substitution of free flap transplantation—periosteum, fat, or fascia—was a decided advance. Foreign bodies have all been discarded but Baer's membrane to which the author is faithful and may be with reason.

And further progress is perhaps to be found in the proposition that a new joint can just as well remain movable even without flap transplantation and without resorting to extensive excision. Schmerz and Schepelmann have demonstrated this fact clinically and experimentally, Schmerz emphasizing the importance of a complete fine polishing, with files, of the bone ends, and Schepelmann especially permanent extension and function to which he gives all credit.

This theory seems to me well supported by embryological facts, by a study of the old experience in joint excision, and by experimental and clinical study of the transplanted flaps. Let us consider this question briefly. The experiments and the interpretations do not agree. One theory is that there is a complete substitution of the flap by new tissue, while another theory is that the flaps heal and undergo a transformation either into connective tissue or into a sort of hygromatous tissue. Others believe that the flaps are a danger to mobility through adhesions and only when they disappear can mobility be obtained.

Also the anatomical investigation of tissues removed at operation has not always disclosed the same findings. Every one admits that the bone surfaces are covered by a connective tissue, which is smooth and more or less hard and flattened where there is friction and pressure. Putti found that a fascial flap after 3 years was transformed into a connective tissue with a cartilaginous new formation. Lexer found, healed and intact as when grafted, a flap of fat which had been transplanted into a hip joint, because of dislocation of the femur and non-use of the limb. It seems to me that even granting the possibility that the flap may remain vital to a certain extent, I think that it does not influence the mobility of the new joint simply because of its presence, but because it regulates the proliferation of tissue. In cases in which the Baer membrane or fat flap is used the general law as applicable to every graft holds true, that a substitution of new tissue from the guest takes place. In cases in which fascial flaps are used I believe they act as a frame along which new tissue will grow. While the superficial layer is destined to disappear quickly, the deep layer in contact with the bone heals totally or partially, but finally and later is replaced by new-growth. However, as this layer is not dead material, it does not produce irritation; consequently the new tissue proliferation is limited within its boundary and the flaps then act as regulators of growth.

If the function of the new joint is active the result seems to be the same, whether the Baer membrane, the fat, or the fascial flap is used. But most important is the fact that a similar result can be obtained without

interposition, and Schmerz has described anatomical specimens from man which have the same structural character of connective tissue and of chondroid tissue as in the case of flap grafts.

Are we to expect that arthroplasty will soon follow the fatal stages of every new operation?

From the first stage of simplicity an operation goes through a second stage of so-called perfectionizing which is generally one of complexity to come back, after experience and disillusion, to a third one much nearer to the starting point.

So we will probably finally come to believe that the only salvation is not in flap transplants, but that the old time-honored resection, if properly accomplished and if followed by permanent extension, by proper changes of postoperative position, and by active movements, will perhaps yield satisfactory results in most cases. Certainly this is true in dealing with affections of the jaw, of the elbow, and perhaps also with those of the shoulder and hip. For the knee, however, experience is too limited and it is better to give the patient the full benefit of the doubt and place a thin fascial flap on each bone surface.

Even if the principle of flap interposition should later be discarded, and it does not seem that this will happen, it has been most fruitful just as so many other working hypotheses have been in other lines, in promoting joint surgery and bringing about the practical conclusions. It has helped to extend the benefits of such operations in many other disabling conditions of joints and its use may possibly be extended to include tuberculous cases.

This is still a difficult question and scarcely studied by surgeons. Especially today when current opinion is for conservative treatment in tuberculous cases, it will seem rather hazardous to present the possibility of mobilizing the joints, but I hope to have some few sympathizers among you, who believe as I do that extremely conservative measures are just as bad as extremely radical ones. Certainly sun treatment, X-rays, sea and mountain treatment, and iodine injections can do wonderful things. A. Bier claimed that even in the plain, with sun or artificial light, with passive hyperæmia and with large doses of iodide of sodium he could cure every case with but extraordinarily few exceptions. I am very loath to doubt other people's results, but if Bier is able to secure such results it has not been possible in other hands. And what can we say of sun treatment if Swiss surgeons say that notwithstanding their sun and their mountains, they must still resort to operative measures (Hotz)?

For the poor classes, I maintain that the operative treatment can be resorted to oftener and that such treatment will secure beautiful results if the operation is done by an experienced surgeon who can execute a really radical excision and who believes in the principle of never draining except in the presence of sepsis, and who can personally watch and supervise the after-treatment.

I beg of you to consider for a while that in tuberculosis of the elbow, excision of the joint gives a high percentage of cures with mobility, that a good percentage of mobility is obtained in the shoulder joint, and that the knee-joint excision followed by ankylosis almost invariably cures every case, with primary reunion and without recurrence.

If such are the results, that is if excision really removes all the tuberculous tissue why should we not aim to give to the patient a movable joint?

Present clinical experience is against such an idea, but the lack of success, as I must confess to have seen in many cases, does not in my opinion alter the soundness of the principle. It is a question still of its practical application. I believe that in such cases flap interposition should not be tried. The bone surfaces should be carefully burned with cautery and a fine film of iodoform either spread over them and the joint re-united by first intention without drain, or drained only for a very short time. For the after-treatment I believe that complete immobility for 2 weeks in extension is the best procedure, slowly proceeding with active and passive movements and changing the position of the limb, continuing extension for a long time if needed. Some possible limited recurrences can be well cured by iodoform, iodine, or carbolic injections.

Let me finally remind you that John B. Murphy wrote in 1904 thus: "In a large percentage of cases in which I formerly did an excision I now feel that the bony destruction was of such mild degree that an interposition arthroplasty might have been performed and the motion in the joint restored."

We are still far from reaching this ideal but I feel convinced that in properly selected cases it must be our final aim.

I would like to go a little deeper into the question of arthroplasty and to consider its indications, technique, and the end-results, and to compare such results with those of transplantation of joints and of cartilage, operations exceptionally used and which should perhaps be abandoned. But a field of such magnitude can be discussed only from a general point of view in an oration such as this, as details are apt to be tedious and certainly are of interest only to a few specialists.

I will say only that the final results in arthroplasty have not been uniformly satisfactory. The results are good in perhaps only 50 per cent of all joint cases. In the treatment of ankylosis of the knee, which should be the proof of the value of the method, mobility and stability have been secured only by a few operators in a good proportion of cases, while the majority have secured results which are poor—15 per cent according to the statistics collected by Henderson. I believe that such results are due especially to the fact that the question has been attacked chiefly in regard to the bone and to the interposition. But the knee has such an important and powerful muscular extension apparatus and the flexion is so intimately connected with its capability to resume its function that unless we have these factors in mind results will not be favorable. The condition of the superior articular pocket and its intimate relation with the intermediary portion of the rectus muscle, are factors of such importance and insufficiently looked for, that it is no wonder if results are not uniformly good. Moreover the condition of the new scar tissue forming around the joint and how much the failures are due to it are not well known.

Perhaps we may expect that future or postoperative treatment consisting in local injections of substances preventing pain, or of something capable of inducing softening in the connective tissues and formation of hygromatous cavities or of substances capable of digesting and re-absorbing scar tissue may be of the greatest importance. I will mention only the intra-articular and peri-articular injection of blood, blood serum, gelatine, salt solution, used by Bier and a novocaine pepsin iodine colloid solution used by Payr.

May we hope that the new deep, germicidal, chemical substances combating successfully joint infection, that the cellular stimulant working on acute and chronic cases, and that the therapy used to produce digestion and resorption of the scar tissue will bring about a revolution in joint surgery.

Certainly this field is enormous and we are working in the right direction in trying to prevent and to perfect operative technique in dealing with these joint lesions.

You will excuse me for having touched only upon these few points; to do more would have been impossible when one considers the many biological, physiological, and pathological possibilities of the joints.

I would feel very well satisfied if I have succeeded in awakening an interest of some in these questions. I hope I have reached the goal I sought in paying a tribute of admiration to John B. Murphy as a pioneer worker in this field as he was in many others, and in so doing if I have been able to present adequately not only what he did but what he made others do and if I have made you feel that his powerful personality, his dynamic influence are still dominating and inspiring men who are working along the paths he has opened to investigation.

A COMPARATIVE STUDY OF TWO SERIES OF GALL-BLADDER LESIONS[1]

By JOHN G. CLARK, M.D., F.A.C.S., Philadelphia

NOW that the primary mortality of standardized operations has almost reached that irreducible minimum which Maurice Richardson has so well said would never wholly be eliminated, we have all turned more intensively toward the investigation of the vital traceries which are made by our patients after they are discharged from the hospital.[2]

The laboratory is a never-ending source of medical uplift, but investigations within this domain take chiefly into account the past and present status of the patient. A great improvement in health or a restoration to full-working capacity is, however, of decisive interest to the surgeon and to the patient, for this is the final test of the real value of surgical intervention. In my Clinic we have all experienced the value of this study of massed statistics, and without this striking of the balance sheet, a real menace to truth may be masked by such expressions as "it is my opinion" or "according to my experience," etc. Even with carefully digested data as a basis for statistics, decided errors may still creep in unawares. At a previous meeting of the American Gynecological Society, I reported a series of 159 cases of cholelithiasis and cholecystitis.[3] In this series the proportion of cholecystostomies to cholecystectomies was in the approximate ratio of two to one. Since then 159 additional cases have been operated upon, and the relationship between these two operations has almost exactly been reversed.

It has been interesting to ascertain the underlying motive for this revolution. One might accredit it to a national change in surgical modes, and certainly this assumption has a very considerable basis in fact, for it is rare indeed to find a surgeon so adamantine in his views that he is not influenced by collective professional opinion. At approximately the time when our first series was published, a general impression obtained in most American clinics that even a well-executed cholecystostomy as a healing agent was not so efficient as had been anticipated. The primary mortality was not high, but the subsequent morbidity was such as to cast a shadow upon its unqualified value as a wholesale measure. As we analyzed our unsatisfactory results in this first series, the errors were ascribed to two sources: first, a failure to remove a number of irretrievably diseased gall bladders, and second, to the postoperative sequelæ, which may result from adhesions around the tract of any intraperitoneal drain. Unquestionably, too, we were influenced by the misleading thought that a cholecystostomy was a less perilous, and, therefore, a more conservative operation so far as immediate mortality was concerned. In the development of the technique of cholecystectomy this assumption has proven erroneous, for it is actually less dangerous and certainly is followed by a better immediate convalescence. It was, therefore, without trepidation so far as this hazard was concerned that we turned from the first to the second measure. It now remains to be seen whether the extirpation of the gall bladder carries in its remoter train of events disabling consequences, which may again bring these two procedures to nearer an equal ratio.

In our original series we discussed these cases under three headings: operations for cholelithiasis and cholecystitis; second, operations for more than one condition, the cholelithiasis or cholecystitis, with definite symptoms, being a coincident part of the combined operation; and a third class, in which a cholelithiasis was found as a mere incident of a routine intra-abdominal examination at the time of another operation, but unattended with any subjective symptoms.

In a few of the earlier of these cases the gall bladder was stitched to the ventral peritoneum

[2] American surgeons are under deep obligations to Dr. Emery Codman for his crusader-like insistence upon the vital necessity for a complete trial balance of remote surgical results.

[3] Ultimate results secured from surgical intervention in simple cases of cholelithiasis and in cholelithiasis discovered during operations for other conditions. Am. J. M. Sc., 1914, November.

[1] Presented before the American Gynecological Society, Washington, May 1-3, 1922.

TABLE I.—COMPARATIVE STATEMENT OF SIMPLE AND COMBINED GALL BLADDER OPERATIONS PRIOR TO 1914

By Frank B. Block, M.D., Philadelphia

	Per cent Simple gall-bladder operations	Per cent Combined operations with gall-bladder symptoms	Per cent Combined operations without gall-bladder symptoms	Per cent Total
Number of cases	[illegible]	[illegible]	[illegible]	[illegible]
Percentage of cases traced	[illegible]	[illegible]	[illegible]	[illegible]
Average age of patients	[illegible]	[illegible]	[illegible]	[illegible]
Average number of days in hospital	[illegible]	28.6	[illegible]	20
Complications of convalescence				
Infection	[illegible]	[illegible]	[illegible]	8.2
Prolonged vomiting	[illegible]	[illegible]	6.4	1
Phlebitis	2.0	2.6	[illegible]	[illegible]
Pneumonia	[illegible]	1	[illegible]	.6
Returned for second operation	[illegible]	[illegible]	[illegible]	[illegible]
Postoperative history				
Cured	[illegible]	[illegible]	[illegible]	[illegible]
Great improvement	[illegible]	[illegible]	[illegible]	[illegible]
Slight improvement	[illegible]	[illegible]	4	[illegible]
Unimproved	[illegible]	8.7	[illegible]	[illegible]
Worse	[illegible]	[illegible]	[illegible]	[illegible]
Died in hospital	(Combined mortality)			

TABLE II.—COMPARATIVE STATEMENT OF SIMPLE AND COMBINED GALL-BLADDER OPERATIONS, SERIES FROM 1914 TO 1922

By Charles A. Behney, M.D., Philadelphia

	Per cent Simple gall-bladder operations	Per cent Combined operations with gall-bladder symptoms	Per cent Combined operations without gall-bladder symptoms	Per cent Total
Number of cases	[illegible]	[illegible]	[illegible]	[illegible]
Percentage of cases traced	96	90	[illegible]	[illegible]
Average number of days in hospital	25.8	26.6	[illegible]	[illegible]
Complications of convalescence				
Infection	0	7.6	[illegible]	[illegible]
Prolonged vomiting	[illegible]	[illegible]	[illegible]	[illegible]
Phlebitis	3.2	2.6	[illegible]	[illegible]
Pneumonia	[illegible]	[illegible]	[illegible]	[illegible]
Postoperative history				
Cured	[illegible]	[illegible]	[illegible]	[illegible]
Marked improvement	8.2	16.4	[illegible]	[illegible]
Slight improvement	20.1	7.5	[illegible]	[illegible]
Unimproved	6.2	8.0	[illegible]	[illegible]
Worse	0	0	[illegible]	[illegible]
Returned for second operation	[illegible]	[illegible]	[illegible]	[illegible]
Died in hospital	(Combined mortality)			

One case re-operated upon in another hospital.

and drained. Experience soon demonstrated the fallacy of this procedure, for not infrequently fistulæ persisted to a disheartening longevity and the patient was annoyed by more or less pain at the point of suspension of the gall bladder. This method, therefore, fell into disrepute and instead the gall bladder was drained *in situ* with a special inset tube and an immediate betterment of postoperative tugging pains was noted. The days in the hospital were materially reduced on an average in all three subdivisions above noted from 33 to 25 days, with a material benefit in every way. Now that the morale of the patient as a health-promoting factor is having such just consideration, we appreciate the fact that every postoperative annoyance eliminated is a big stepping stone toward a cure. With our present technique, the gall-bladder drainage practically always ceases within a day or so after the tube is withdrawn. Even under these more favoring conditions, there still remains a definite percentage of patients who complain of pain in the biliary region, which was not an ante-operative symptom and unquestionably emanates from adhesions which hinder the action of the gall bladder, or cause distress in adjacent viscera. By the patient this symptom is often designated under the all-inclusive expression, "indigestion."

In this series of 159 cases, there were six deaths—one from cholæmia due to an extensive destruction of the pancreas, the second from cholæmia in a case of an associated operation for a large incarcerated umbilical hernia in a very stout patient, and a third from cholangeitis and pancreatitis, in which a stone was imbedded in the pancreas and was not found until autopsy. The fourth was from a gradual failure in an advanced case of pancreatitis induced by cholelithiasis, the fifth from peritonitis in an associated hysterectomy for chronic metritis, and the sixth from a subphrenic abscess due to leakage of the drainage tube. In four of these cases death was due to the hopelessly destructive results incident to a long-standing cholelithiasis, an irreducible minimum as designated by Richardson. The other two fatalities may be considered as of the preventable type.

In analyzing our statistics we find 118 cholecystostomies and 41 cholecystectomies in this first series. There were four postoperative fatalities among the 118 cholecystostomies including the combined operations, and two among the 41 cholecystectomies. As the result of our follow-up letters and through personal consultations, we were able to trace 85 per cent of these patients. Among these 118 cholecystostomies, of which 95 were traced, there were 64 complete cures, 6 were markedly improved, 11 slightly benefited, and 12 were

TABLE III.—COMPARATIVE STUDY OF CASES PRIOR TO 1914
By Frank B. Block, M.D., Philadelphia

	Per cent Simple gall-bladder operations	Per cent Combined operations with gall-bladder symptoms	Per cent Combined operations without gall-bladder symptoms	Per cent Total
Average days in hospital				
Cholecystectomy	27.0	29.6	24	28.5
Cholecystostomy	28.9	29.1	28.0	28.9
Cures				
Cholecystectomy	15	7	3	25
Cholecystostomy	8	18	17	43
Marked improvement				
Cholecystectomy	4	2		10
Cholecystostomy	1	4		11
Slight improvement				
Cholecystectomy	2	2	0	4
Cholecystostomy	3	3	0	8
No improvement				
Cholecystectomy	0	1	2	3
Cholecystostomy		8	1	9
Died				
Cholecystectomy	1	1		2
Cholecystostomy	1	0	0	1
Returned for operation				
Cholecystectomy	0	1		2
Cholecystostomy	2	7	0	9

Two cases re-operated upon were done in other clinics.

Symptoms present in 104 cases	Cases	Percentage
Indigestion	57	54.7
Pain	93	89.4
Jaundice	16	15.6

TABLE IV.—COMPARATIVE RESULTS OF CHOLECYSTECTOMY AND CHOLECYSTOSTOMY, SERIES FROM 1914 TO 1922
By Charles A. Bahrenburg, M.D., Philadelphia

	Per cent Simple gall-bladder operations	Per cent Combined operations with gall-bladder symptoms	Per cent Combined operations without gall-bladder symptoms	Per cent Total
Average days in hospital				
Cholecystectomy	25.9	27.4	33.0	26.3
Cholecystostomy	25.2	24.8	23.5	24.3
Cures				
Cholecystectomy	7	29.5	100	80.2
Cholecystostomy	33.3	43.5	85.7	47.6
Marked improvement				
Cholecystectomy	7.1	9.1	0	6.9
Cholecystostomy	16.7	30.4	0	21.4
Slight improvement				
Cholecystectomy	16.2	6.8	0	11.0
Cholecystostomy	8.3	8.7	14.3	11.3
No improvement				
Cholecystectomy	0	4.5	0	2.2
Cholecystostomy	25.0	17.4	0	16.6
Died				
Cholecystectomy }	(Combined mortality)			1.9
Cholecystostomy }				1.9

Symptomatology	Percentage
Indigestion	58.1
Pain	78.4
Jaundice	21.2

in no way helped. Of the unimproved cases, 7 were subsequently subjected to cholecystectomies, and 2 were re-operated upon for adhesions in the upper abdomen. There were 41 cases in which cholecystectomy was performed with the following results: not traced, 4; surgical deaths, 2; cured, 21; marked improvement, 2; improved, 6; and no improvement, 5.

Behind these bald statements as to results, there is much of statistical interest, such as the immediate convalescence of the patient, etc. In general we may state without reservation that the postoperative complications in the cholecystectomized patients were less in evidence and the patients were far more comfortable than were those in whom biliary drainage was maintained for 10 days. This was manifestly due to the fact that, at most, only a small cigarette rubber drain was employed and this was usually carried through a peritonealized channel in the groove of the liver to the site of the cystic excision.

Furthermore, as we reviewed these two series of cases we gained the impression, as so many surgeons have, that the interest of the patient is fostered by a more frequent resort to cholecystectomy, and as will be seen in a review of the operations which were performed after 1914, this revised policy was carried out so much more frequently that the ratio of cholecystectomies to cholecystostomies, which was two to one in the above series, was reversed. It will be of interest, therefore, to compare the follow-up studies in the two series. With the methods of drainage which we now employ (Figs. 3 and 4), the biliary fistula almost immediately closes upon the withdrawal of the tube and the stay of the patient in the hospital is consequently shortened. We may say, therefore, that this method of drainage in keeping the gall bladder empty without any contamination of the peritoneum is most satisfactory; nevertheless any foreign body which remains in the abdominal cavity from 5 to 10 days even though its contact with peritoneal surfaces is slight, will inevitably cause adhesions. While the adventitious peritoneal bands and web-like adhesions cause no subsequent discomfort, or they are at most of a fleeting character, in a large percentage of cases, in a smaller ratio very annoying and even seriously threatening or disabling complications may arise. From this standpoint, therefore, a cholecystectomy has a decided advantage. The convalescence, so far as the healing of the wound, the absence of an annoying drainage tube, a lessened frequency of postoperative adhesions, and a lower mortality, points more favorably

to a cholecystectomy as the method of choice, but does the remoter course of these cases sustain this operative preference? Because a cholecystostomy in the past has been considered less hazardous than a cholecystectomy, we may for convenience of comparison designate the foregoing series as the conservative, and the series now to be reviewed as the radical, although in the light of our present knowledge we realize that this is a misleading differential caption.

THE MORE RADICAL SERIES

The returns from our follow-up system show that 94 per cent of cases have been traced. It is a remarkable coincidence, and not by design, that the tabulated cases in this series were identical with the foregoing, viz., 159. Of this number there were 108 cholecystectomies and 51 cholecystostomies, a reversal of the previous ratio of two to one. There were five deaths among the entire number.

As the question of the fatalities is a most important point, it will be of interest to analyze the lethal causes with a view to ascertaining which may be classed as properly belonging to the irreducible minimum. The first occurred in an aged woman with a chronically inflamed and greatly shrunken gall bladder, with adjacent adhesions causing an obstruction of the pylorus. On removing the gall bladder it was found to be malignant. A posterior gastro-enterostomy was performed for the temporary relief of the pyloric obstruction. Death followed within a few days from an obstructive jaundice and cholæmia. The second occurred in a frail woman, a bedridden invalid for more than a year. The gall bladder was the seat of a chronic cholecystitis of an interstitial type, and it was also much shrunken, but the operation was very easy and uncomplicated. One hæmorrhoid was ligated and excised. Death occurred on the fifth day from pneumonia. The third death occurred in a patient upon whom a cholecystectomy had been performed for cholelithiasis and chronic appendicitis. A day before the expected discharge of the patient from the hospital after an uncomplicated convalescence, the lethal exitus came from a pulmonary embolus. The fourth fatality was caused by peritonitis after an operation for a simple dermoid cyst with coincident cholelithiasis. At autopsy the common gall duct was found to be dilated and contained a considerable accumulation of fine sand, which, however, did not block the channel. The pathologist was unable to ascertain the source of the peritoneal invasion. The fifth patient succumbed on the eighth day, after an uncomplicated hysterectomy for a myoma and a cholecystectomy. During the immediate convalescence there was no sign of danger. The temperature and pulse tracings ran a very satisfactory course until the eighth day when the patient was seized with severe pain in the splenic area and died within 6 hours. Upon autopsy the general peritoneal cavity was found free from evidences of peritonitis and death had occurred from the rupture of a subsplenic abscess. The surgical fields were quite normal. Sections of the spleen showed it to be the seat of an extensive chronic splenitis. As to the source of this infection, the pathologist could offer no explanation.

Viewed from the critical standpoint, one of the patients was irretrievably lost before she reached the operating table, as no measure can rescue a patient suffering with carcinoma of the common duct. Thus far no method of treatment can divert the occasional shaft which kills through pneumonia and embolus. We have, therefore, in this list of fatalities only two which might have been circumvented, both of which we count as surgical infections. The total mortality for the straight and combined operations was 3.7 per cent—were we to throw out of account the case of carcinoma of the common duct with ante-operative gastric dilatation, the mortality would be only 2.5 per cent. It will thus be seen that even when some other operation is a coincident part of a gall-bladder operation, the mortality is still within satisfactory bounds. However, we are particularly careful in our restriction as to these combined operations. In several cases in which there have been no preceding symptoms of cystic involvement, gall stones were discovered during the course of the general intra-abdominal examination but no intervention in this direction was attempted because the patient's con-

dition was not wholly satisfactory and an extra risk should never be run in such cases, for a second operation may be held in abeyance until the symptoms necessitate or the patient under advice chooses to have the stones removed at a more propitious time. Even in the presence of well-defined symptoms in the upper abdomen, if the lesion in the lower abdomen is of an infectious character, we intermit the manual exploration of the suspected locality. As to the stay in the hospital of this series, in general it has been lessened. Our statistics show an average decrease of three days. Were we to have struck the average of 158 cases it would have been still two days shortened for the one hundred and fifty-ninth patient suffered with a prolonged bronchopneumonia and remained in the hospital over 3 months. The wound infection, which was 8.2 per cent in the first series, dropped to 4.4 per cent in the second. Phlebitis in one series was 2.5 per cent in the first, and 2.2 per cent in the second. As will be seen in the comparative statistical table which shows several other details of convalescence, the results in the second excel those of the first. As to positive cures of the entire series, the results are about the same. When it comes to the relative difference between the qualified improvements and the unimproved, our statistics are distinctly in favor of the cholecystectomized patient. In other words, it would appear that the total removal of the gall bladder might be extended to still a larger percentage of cases. We hesitate, however, to make this suggestion, for we feel convinced that the probability of improvement lies in lessening the number of drainage cases, and we are in full accord with Willis and others who advocate this reduction on a well-grounded statistical basis. In symptomless cases of cholelithiasis, we are substituting the ideal operation. In such cases a cholecystectomy with closure of the gall bladder is a highly satisfactory procedure, and likewise when the gall bladder is diseased an uncomplicated cystectomy is equally safe without drainage. An increase in the number of cures will, therefore, in our opinion be facilitated greatly by less drainage, for the untoward symptoms which throw discredit upon gall-bladder surgery is largely to be

Fig. 1. The gall bladder is drawn up into easy accessibility through gentle traction with Allis forceps and an opening is made with scissors. Before this step is attempted the greatest care must be observed in protecting the peritoneum, with gauze packs, from possible contamination.

credited to this error. Finally, at least a 10 per cent margin must be left which will include the unimproved class. In this discard will be found cases in which the results of the biliary, pancreatic, and gastric disturbances are so advanced when any operation is performed that they are really beyond the possibility of relief by surgery.

As we have studied the chronic cases, the same surgical cry arises as in many other diseases amenable to the benefits of any early operation, for we so often find that the uncured patients are among those who have suffered repeated attacks running over years. All too frequently they have passed the surgical boundary, because they no longer suffer solely from disease of the gall bladder but from a chronic infection of the biliary and pancreatic systems, with the extracystic anatomy so changed that no means will restore it, hence a persistently disabling or mortal disturbance of function will continue after any operation. Too often the attacks which may be far apart, with only moderate symptoms of indigestion in the interim, are treated tenta-

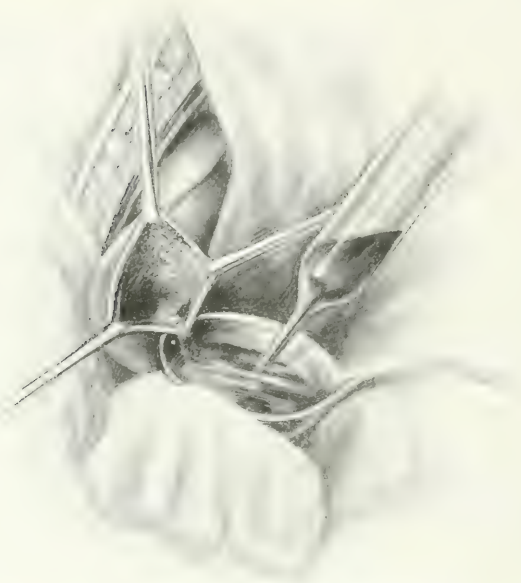

Fig. 2.—Biliary spoon adjusted so that the bile flows easily into it. At the same time an assistant keeps the spoon evacuated with a syringe so that there shall be no overflow. The interior of the gall bladder is open to complete inspection and gross changes are at once detected, thus rendering easy a decision for or against cholecystectomy.

tively until an operation ceases to be elective and becomes immediately urgent. To illustrate this point, I again quote Richardson, who compared the quiescent gall bladder containing gall stones, to the phlegmatic old farm horse which placidly jogs down the country road month in and month out, oblivious to all scares in the roadway, but to the farmer's astonishment some trivial phantom causes him to run away with more or less tragic consequences. Never again can you trust that horse for he can no longer be designated as "Old Safety," for he will again run away. So with the quiescent cholelithiasis which finally precipitates a biliary colic; from that time on the patient's safety is so much jeopardized by recurring attacks that an operation becomes unequivocally indicated.

TECHNICAL POINTS

The use of a trocar for evacuation of the gall bladder has always been more or less unsatisfactory, because it not infrequently fails and even when successful the appearance of the cystic contents, unless actually purulent, gives but little real evidence of diagnostic value. Therefore, we bring the gall bladder well up into the field of vision through Moynihan's excellent method of hepatic rotation which is available in a large proportion of cases. Following Crile's suggestion a small patch is then excised from the dome of the gall bladder and its contents is emptied into a biliary spoon (Figs. 1 and 2), from which it is quickly withdrawn with a large glass syringe. By careful preliminary packing, the peritoneum will not be contaminated, and after the

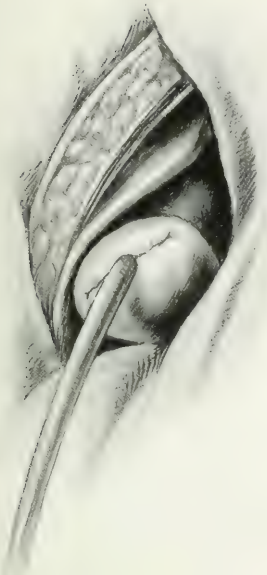

Fig. 3. The drainage tube is held securely in gall bladder. To secure the most accurate water-tight closure, a Cushing stitch of fine Pagenstecher thread is used. Before the abdominal incision is closed, salt solution is gently injected into the gall bladder, thus testing the patulosity of the drainage tube, the security of the closure, and the washing out of small blood clots.

gall bladder is thus emptied and the stones, if present, are extracted, its mucous membrane may be inspected. If of a strawberry type, or if it shows evidence of a chronic cystitis, ulceration, or atrophy, or there is great thinning from overdistention, it is removed. Only when it appears visually normal is it drained or closed by the ideal method. By this direct inspection, the possibility of error as to the necessity for a cholecystectomy is reduced to a minimum. In our experience, therefore, this evolution in diagnostic technique has been of real and positive value.

A second point as to drainage. The gall-bladder tubing must be so arranged that the incidence of postoperative adhesions is reduced

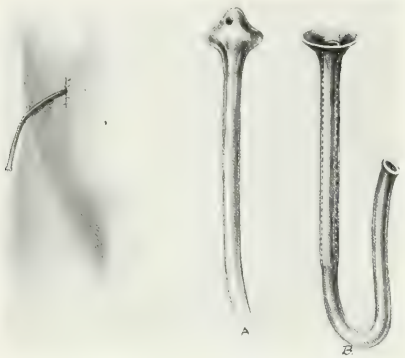

Fig. 4. The drainage tube is usually brought out through a stab wound. (a) A self-retaining vesical catheter is utilized in making the gall-bladder drain. The bulb is cut off along dotted lines, thus leaving a rubber flange which serves as a valve when the tube is sutured into the gall bladder. (b) A ductile metal tube is inserted into the catheter which keeps it rigid and free from kinking and yet permits a satisfactory adjustment to the abdominal wound.

to its lowest possibility. All too frequently in the past the drainage tract has been established through the primary abdominal incision. To obviate this error, which may incapacitate the gall bladder from proper functioning because of a bad anatomic position, not infrequently a second stab incision is made to the right at a convenient site, thus promoting drainage at a more dependent point. Furthermore if the gall bladder is drawn well away from the duodenum and pylorus, the gastric, duodenal, or biliary functions are subjected to much less postoperative disturbance in the event of adhesions.

As to the drainage tube (Figs. 3 and 4) we have utilized to great advantage a self-retaining vesical rubber catheter, which is protected against kinking by a specially constructed ductile metal tube, of sufficient length to conduct it through the incision, inserted to the bulb of the catheter. By the use of this very satisfactory arrangement, the drainage canal is rendered fully adjustable to the wound: a source of much greater comfort to the patient during the days of drainage. A stiff tube may be most distressing and a soft rubber one may

be the source of actual danger through kinking and blockage.

CONCLUSIONS

In the comparative study of the accompanying tables one may summarize the outstanding points as follows in favor of cholecystectomy. The postoperative convalescence is decidedly better, the percentage of cures is larger, the mortality is less, and surgical complications are in the minority. Against these advantages may be debited as a danger, the fact that should serious symptoms arise in the cholecystectomized patient which demands a subsequent operation, the opportunity for surgical alleviation is endangered through the absence of the gall bladder. Such operations are more difficult and dangerous, for anatomical orientation is greatly obscured. However, the possibility of a subsequent operation is minimized by the superior results following the removal of the gall bladder when its mucous membrane or mural integrity has been seriously impaired. Such gall bladders under the best of drainage do not tend to spontaneous repair, but frequently the same distressing trend of symptoms recur when the biliary fistula closes. Less drainage and more ideal operations when the gall bladder is intact, and more cholecystectomies and fewer cholecystostomies when it is diseased, would stand out as guiding principles if our observations have been correct.

The decision to subject a patient to an operation for a gall-bladder lesion in the presence of some major or minor abdominal or gynecological ailment must be arrived at only after a rigid weighing of clinical facts such as the condition of the patient to withstand the additional risk and the actual danger to the patient without immediate intervention. In the presence of two lesions it may be wise to abandon the gynecological procedure in favor of the biliary trouble when it is the dominant one. While from the mere scanning of our tables it would appear that these combined operations carry a higher mortality danger, the analysis of results does not sustain this criticism, for in three instances the second operation was too trivial to bear lethal weight in the outcome. In one there was a simple appendicectomy, in a second a small hæmorrhoid was ligated and quickly removed, while in a third a small, uncomplicated dermoid was excised. The primary mortality danger should always stand as a signal barrier to a second operation if it seems to increase the hazards; on the other hand to send a nervous or apprehensive woman from the surgical table with the prospect of a second ordeal facing her is like suspending the sword of Damocles over her head. However, in these crucial decisions a safe dictum is: "In case of doubt, defer the second operation to a more propitious time."

BILE-DUCT ANOMALY AS A FACTOR IN THE PATHOGENESIS OF CHOLECYSTITIS

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DURING the past 3 or 4 years, the literature devoted to the surgical aspects of gall-bladder disease is notable chiefly for two reasons. In the first place we have become more and more familiar with the technical difficulties encountered in the performance of operations for removal of the gall bladder, and repair of the bile ducts; in the second place, we have learned the importance and significance of interstitial cholecystitis associated with infection of the portal circulation and independent of primary intravesical disease.

The data secured recently, from a patient operated upon for gall-bladder disease, illustrates strikingly the anomalies of bile-duct anatomy as a factor in the pathogenesis of cholecystitis, and emphasizes the importance of technique in gall-bladder surgery.

Mrs. I. C., 29 years old, married at the age of 21, the mother of two children, had never been ill since early childhood, when she had measles and scarlet fever. For the last two years and a half, however, she had been plagued by a constant, burning pain just under the right free costal margin. This pain had always been worse at night. But the patient insisted on the fairly constant presence of it during waking hours. In addition to this constant burning pain, she had had, from once to three times a week, acute seizures of "cramping" pains, lasting from 2 to 3 hours, at times radiating to the shoulder, accompanied by nausea, but never by vomiting. There had been no jaundice or other signs of obstruction to the bile current.

Through a pararectus incision the appendix was removed. The liver was rotated upward, so as to deliver a pearl gray gall bladder about 3½ inches long by 1½ inches in diameter, so closely packed with small stones that it felt like a hard, solid organ. The foramen of Winslow was located, and by blunt dissection in the region of the pelvis of the gall bladder the cystic duct was sought. What seemed to be the duct was found without difficulty. The operative field at this stage of the operation is represented in Figure 1. Traction on the supposed cystic duct seemed to indicate its entrance into the gall bladder above, and into the common duct below. Failure to locate the cystic artery in its usual position prompted caution, however, and before the duct was clamped a more careful survey of the field disclosed the fact that the exposed duct was in reality not the cystic, but the common duct. Further exploration disclosed the cystic duct emerging from the gall bladder somewhat laterally (toward the left side), and then, kinking on itself very sharply, it coursed upward along the left lateral wall of the gall bladder for about one inch and a half. The duct then turned to the left to empty in the common duct, as shown in Figure 2. This illustration is necessarily somewhat schematized and does not show the unusual complexity of the anomaly. As a matter of fact the cystic duct, as such, was not recognizable, because it was seemingly incorporated in the gall-bladder wall, much as the appendix is sometimes found to be incorporated in the cæcal wall. Furthermore the posterior wall of the gall bladder was adherent to the common duct, so that when traction was put on the gall bladder the common duct pulled up exactly as would a normal cystic duct. The only definitely discernible landmark was the site where the terminal one-half inch of the cystic duct could be seen coursing toward its entry into the common. Figure 3*a*, a photograph of the gall bladder, shows the cystic-duct relationships as they really existed. The duct coursed alongside the lateral margin of the gall bladder, seemingly incorporated in the gall-bladder wall, extending up as far as the point *A*. After the gall bladder was removed the serosa was nicked with a knife at *A*, releasing the end of the cystic as shown in Figure 3*b*. Further division of the adhesion between gall bladder and cystic duct mobilized the entire duct as seen in the photographs 3*c* and 3*d*.

Division of the cystic duct at its point of entrance into the common duct and mobilization of the gall bladder brought into view the common duct coursing behind the gall bladder and emerging from below its pelvis, in the position normally occupied by the cystic duct (see Fig. 2).

Only the grace of fortuitous circumstance prevented severance of the common duct.

It is perfectly evident from this description that it is not sufficient merely to "expose the cystic before dividing it." It is essential to *identify* the exposed duct as the cystic; and this can only be done by actually tracing it into the gall bladder above, or into common duct below, or preferably by tracing it from gall-bladder emergence to common duct entry.

The importance of such an anomaly as has been described, does not lie solely in the

Fig. 1. View of the operative field with the supposed cystic duct in view.

technical difficulties it creates for the surgeon. Of even greater importance is the relationship between these anomalies and pathological lesions of the biliary tract. The sharp kinking of the cystic duct at its emergence from the gall bladder opposes a barrier to the bile current and results in more or less stasis of the gall-bladder contents (Fig. 4).

In a recent paper, von Schmieden (1) emphasizes the importance of bile stasis. He believes that simple non-lithogenous obstruction to the outflow from the gall bladder may produce initial symptoms not distinguishable from those due to cholelithiasis. The first clinical symptoms of these attacks of obstruction are sharp, relatively short seizures of pain, with tenderness in the gall-bladder region, unaccompanied by fever or jaundice. The later attacks may be accompanied by signs of gall-bladder inflammation. Von Schmieden believes that in at least an appreciable number of cases, the bile stasis in the gall bladder is due to valvular kinking of the cystic duct, occasioned both by its spiral course and by the presence of Heister's valves in the duct. Figure 4 represents the gall bladder of our patient, and shows clearly how the kinking of the cystic duct was responsible for an obstruction to the outflow of bile.

It is well to remember in this connection that the formation of gall stones is supposed to depend either upon primary inspissation

Fig. 2. View of the operative field showing that what was at first supposed to be cystic duct was in reality the common duct.

and thickening of sterile bile due to incomplete evacuation (Aschoff and Bachmeister, 2) resulting in the formation of radiate cholesterin stones; or upon a so-called stone-forming catarrh or inflammation (Naunyn, 3) which leads to the formation of concentric stratified pigmented calcium stones. Most authors believe that stones are formed in accordance with both of these theories. The cholesterin stones, resulting from aseptic bile stagnation, make up about 30 per cent of all cases of cholelithiasis. These so-called aseptic stones, according to Kehr (4), may remain in the gall bladder indefinitely without inducing clinical symptoms in a large proportion of cases, "yet inasmuch as the calculi are formed in stagnant bile, they act as foreign bodies increasing bile stasis. They impede biliary ebb and flow. The contractility of the gall bladder is diminished. Residual bile remains. Further, the porous surface of the calculus and the capillary fluid surrounding it attracts bacteria. Thus the cholesterin stone, originally formed aseptically, becomes by chance an active agent of infection, by hindering the biliary evacuation of the engorged and in-

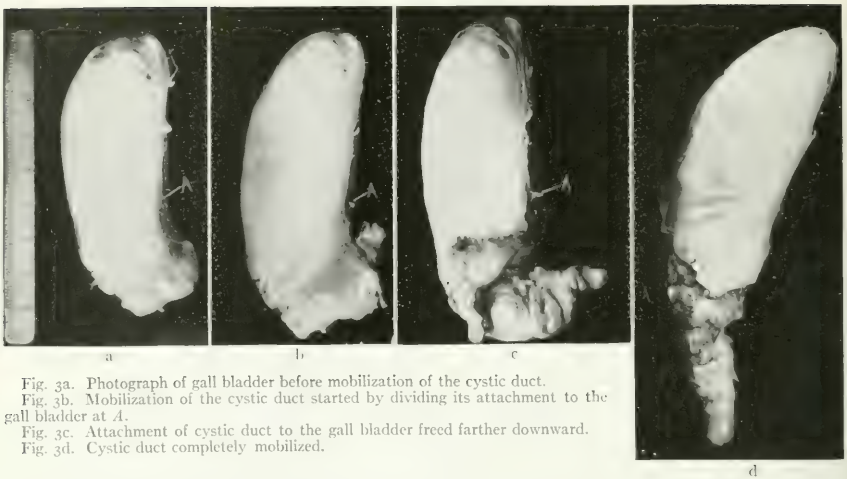

Fig. 3a. Photograph of gall bladder before mobilization of the cystic duct.
Fig. 3b. Mobilization of the cystic duct started by dividing its attachment to the gall bladder at *A*.
Fig. 3c. Attachment of cystic duct to the gall bladder freed farther downward.
Fig. 3d. Cystic duct completely mobilized.

fected gall bladder. Thus the disease progresses from the aseptic stage through the latent period, into the acute inflammatory stage" (Kehr). Aschoff and Bachmeister confirm this opinion. More recently Rous, Peyton, and McMaster (5) have demonstrated experimentally that sterile bile within the gall bladder, under non inflammatory conditions which prevent its discharge, becomes inspissated with surprising rapidity.

From all this, it is perfectly evident that anomalies in the anatomic relations of the cystic duct, such as have been described in this paper, are important factors in the pathogenesis of gall-bladder disease (Fig. 4). They lead in the first place to the prodromal colics, due to interference with normal emptying of the gall bladder. Then follows the stage of non-inflammatory bile inspissation, which in its turn is succeeded by concrement formation with attendant inflammatory symptoms.

Early in this sequence of events there occurs a certain amount of damage to the gall-bladder wall itself. Schmieden, who has made a most careful pathological study of distention of the gall bladder, reports that the first significant changes due to intravesical pressure are the dilatation of Luschka's ducts and a congestion hyperæmia of the wall of the gall bladder (Fig. 5). If the distention persists or increases in degree, the gall-bladder wall shows a characteristic œdema of the fibrous, subserous, and mucous layers, with a hypertrophy of the muscularis and an interstitial lymphocytic infiltration in all layers. Finally a marked fibrosis occurs, particularly pronounced in the muscular coat. The end-result is an atrophy of all the layers.

This pathological picture of interstitial cholecystitis links the problem of kinked cystic duct and consequent distended gall bladder, with the recently published work of Graham (6). Graham has clearly demonstrated for the first time, the existence of interstitial cholecystitis, with infection of the lymphatics of the gall-bladder wall from without, and he has emphasized the significance of this type of cholecystitis as a most important factor in gall-bladder disease. By implication at least, Graham seems to underestimate the significance of interstitial cholecystitis due primarily to intravesical lesions, that is to infections from within the gall-bladder cavity. He lays a great deal of stress on failure to induce cholecystitis by directly infecting the gall-bladder cavity; but he fails to mention the work of Mignot, who showed that cholecystitis resulted if attenuated bac-

Fig. 4. Gall bladder with kinked cystic duct bisected sagitally after hardening in formalin. Illustrates obstructing valve formation due to spur, plus Heister's valve.

Fig. 5. Drawing from Aschoff and Bachmeister to show effect of gall bladder distention in causing widening of Luschka's ducts, hypertrophy of the muscularis, and lymphocytic infiltration of layers of gall-bladder wall.

teria were used. Mignot's work is credited both by Moynihan and by Robson. Graham's experiments do show beyond all doubt the invasion of the gall-bladder wall by the lymphatic route from without, and they do prove the existence of an interstitial cholecystitis totally independent of a primary gall-bladder mucosa infection. His experiments, however, do not disprove the statements of Schmieden or of Aschoff regarding the dependence of interstitial cholecystitis upon intravesical stasis, nor do they disprove the existence of an interstitial cholecystitis secondary to an intravesical inflammation. As a matter of fact Graham does not set up any claims to disprove these things. He merely sets out to emphasize the frequent association of inflammation in the portal territory (appendicitis, peptic ulcer, typhoid, etc.) with cholecystitis. The cholecystitis he proves to be due to an hepatitis, which extends, by way of the lymphatics, to the gall bladder.

It is important for us to bear in mind, however, that in addition to the type of cholecystitis described by Graham, we must still reckon with the two other types of cholecystitis due primarily to intravesical inflammation, and to intravesical stagnation and tension. We must further bear carefully in mind the very explicit statement of Aschoff that "every change in a gall bladder subject to bile stasis may be ascribed solely to increased pressure. Thus the muscular hypertrophy, the enlarged Luschka's ducts, the thickened mucosa folds, and the slight lymphocytic infiltration are all due to increased pressure and increased resorbtive processes incited by the increased pressure." A rational consideration of all factors involved seems to warrant one in concluding that intravesical disturbance is responsible for more gall-bladder disease than is the invasion of the gall-bladder wall by the lymphatic route from without. And even if this statement be open to question, it is true, nevertheless, that the chapter of anomalous and kinked cystic ducts is of commanding importance in relation to the questions of the etiology of cholecystitis and the accidental surgical injury of the bile ducts.

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LIVER ABSCESS

Report of One Hundred Operations[1]

By A. I. LUDLOW, M.D., F.A.C.S., Seoul, Chosen (Korea)

THE following report of one hundred operations for liver abscess is divided into three series.

Series 1. Abscess of the liver (1).

Series 2. Supplementary report (2).

Series 3. Comprises forty additional cases.

Thirty-three of these operations were performed by my Korean associates, Drs. Oh, Pak, Koh, and Pang, and the remaining 67 by myself.

DISTRIBUTION AS TO TIME

According to time the distribution is as follows:

	Cases
1912	5
1913	4
1914	6
1915	12
1916	14
1917	4
1918	2
1919	10
1920	9
1921	18
1922 (To June 1)	7
Total	100

GEOGRAPHICAL DISTRIBUTION

According to Rogers (3): "This disease is met with most frequently in low-lying moist tropical climates. Thus it is common in the large Presidency coast towns in India, at Colombo in Ceylon, Singapore, the East Indies, Philippine Islands, Hong Kong, and the more southern parts of China. It also occurs inland in these countries, being met with in all parts of India, including the comparatively dry Punjab and Central India. In Africa it is not uncommon, in Egypt and Algiers as well as upon both coasts, while cases have also been reported from the interior. It is relatively rare in the West Indies, but occurs to some extent in the hotter parts of both North and South America."

Manson (4) writes: "Its geographical distribution is in the main regulated by that of dysentery. It has to be noted, however, that liver abscess is not a sequel or concomitant of the dysentery of all countries and at all times. Thus it is rare as an indigenous disease in temperate climates, even in those temperate climates in which dysentery is at times common enough."

In view of this statement of Manson, it is of interest to note the large number of cases met with in Chosen (Korea), a country of temperate climate. The Government Hospital in Seoul has had 49 cases of liver abscess from 1913 to 1920. Of these 46 were males and 3 females. The age incidence is practically the same as that reported in our series.

Reports from hospitals outside of Seoul show that liver abscess occurs in all parts of Korea.

PREDISPOSING CAUSES: RACE, AGE, AND SEX INCIDENCE

Race. In tropical regions the whites are far more subject to liver abscess than the natives. It has been pointed out that passive congestion of the liver is a common condition among the white inhabitants of tropical regions and that liver abscess is particularly common among white persons that abuse alcohol. A striking feature of our series is that all the patients were Koreans. We have had no cases in our American or European population (almost all of whom are treated by our staff) although amœbic dysentery is of common occurrence, about 1 in 5 having suffered from this disease. We attribute this in part to early and energetic treatment of amœbic dysentery with emetine. The climatic influences of the tropics are absent and the use of alcohol is not frequent in the white population of Korea.

Age. The following table shows the age and sex incidence of the 100 cases:

[1] From the Surgical Department, Severance Union Medical College, Seoul, Chosen, Korea.

	Males	Females	Total	Percentage
0 to 10 years	2	0	2	2
11 to 20 years	3	1	4	4
21 to 30 years	55	4	59	59
31 to 40 years	34	2	36	36
41 to 50 years	13	1	15	15
51 to 60 years	1	0	1	1
Total	92	8	100	100
Percentage	92	8		

These figures of age incidence correspond closely with those reported from India.

In our Series 1, the age ranged from 7 to 50 years; average 25 years. There were two males, 7 and 10 years of age, in this series.

In Series 2, the age ranged from 21 to 53 years; average 32 years.

In Series 3, the age ranged from 16 (female) to 53 (male); average 33 years. The average for the 100 patients was 30 years.

Sex. In Series 1, there were 27 males and 3 females.

In Series 2, there were 29 males and 1 female.

In Series 3, there were 36 males and 4 females.

A total of 92 males and 8 females for the combined series, 100 patients.

Many writers have emphasized the great rarity of liver abscess in females. Rouis (5), De Castro (6), Barensprung (7), and others lay stress on this point. Rogers (3) reported only 8 females in a series of 300 cases of liver abscess. It will thus be seen that our series shows the highest percentage of females, at least so far as we have been able to find in the literature. We have about four times as many operations on men as on women but this would account only in small part for the greater number of males. While our percentage is larger than others report, nevertheless the rarity of liver abscess in females is still a striking fact.

Alcohol. One of my Korean associates made the remark one day that he observed that many of the patients who came with liver abscess were addicted to alcohol. Our records are not sufficiently accurate on this point, but I do know that many of the patients used Korean wine. The majority of our cases were also people who use alcohol.

ETIOLOGY

None of our cases gave a history of special trauma, secondary processes from the appendix or gall-bladder infection, in fact, the latter infections are not at all common in Korea. About 90 per cent of our cases were at some period associated with diarrhœal conditions the majority of which were probably amœbic in origin, at least the history would indicate this diagnosis. Furthermore amœbic dysentery is frequent in this locality, and, as a rule, the Koreans pay little attention to its treatment but as they say, "Allow it to run until it stops."

Amœba histolytica was found in 10 per cent of the 50 cases in which fæcal examination was made. I have no doubt that this percentage would be much greater if repeated and special search had been made for the amœba. It should also be remembered that several of the early cases were operated upon before our laboratory work was well organized. Although amœbæ have been discovered in the walls of some of the abscesses and there have been reports of primary sterility of the pus yet these reports are not sufficient in number to be of special value. In practically every case the abscess has developed slowly and at times with no history of fever.

As recorded later many cases had no fever upon admission to the hospital. Most of the cases have been large single abscesses well localized and presenting dense fibrous walls (see Fig. 1). All these facts agree with the usual etiology of tropical abscess of the liver.

THE ABSCESS

Number of abscesses. All the abscesses in the individual lobes were single or easily converted into single abscesses.

Size of the abscesses. The size varied from a cavity 4 centimeters in diameter to those which involved nearly the entire lobe holding a liter or more of pus. Those which had ruptured contained as much as three liters. The pus was dark red in color, of foul odor at times, and in some cases contained large shreds of liver tissue. In some of the large abscesses the first pus was thin followed later by pus so thick that it had to be scooped out.

Position of the abscess.

	Right lobe only	Left lobe only	Both lobes
Series 1	28	0	2
Series 2	29	1	0
Series 3	36	1	3
Total	93	2	5

COMPLICATIONS

a. Intestinal parasites. Intestinal parasites are very common in Korea and were found in 45 out of 50 cases in which fæcal examinations were made, as follows:

Parasite	No. of times
Trichuris	40
Ascaris	30
Amœba histolytica	10
Ankylostoma	7
Tænia	5
Oxyuris	5

b. In the sputum of seven patients the ova of paragonimus westermanii were found. Distoma is common in Korea. In 2 cases the sputum showed tubercle bacilli.

c. Rupture in the pleura occurred in 9 cases.

d. Rupture through the chest wall with large ulcer, 1 case.

e. Necrosis of the ribs, 5 cases; two preoperative and three postoperative (see Fig. 2).

f. Rupture into the abdominal cavity, 5 cases (see Fig. 3).

g. Albumin in the urine, 6 cases.

h. Ascites was present in 6 cases.

i. Morphine habit, 1 case.

THE BLOOD

Marked anæmia was present as a rule only in those cases in which there were complications, for example, in the hookworm patients. One patient with both distoma and hookworm had 45 per cent hæmoglobin and 2,500,000 red cells. The uncomplicated cases had a fairly normal blood count. Very few presented a high leucocytosis, 27,400 being the highest reported. Some of the patients with the largest abscesses showed a normal number of white cells.

SYMPTOMS

While the symptoms presented were variable, yet almost every patient gave a history of diarrhœa, fever, chills or sweats at some time during the period of illness. Pain in the right hypochondrium especially on pressure is also present. The following records of pulse, temperature, and respirations of cases at the time of admission to the hospital show how these signs may be of little help.

These were selected at random from the series.

Pulse	Temperature	Respirations
68	36	18
76	36	18
120	36·5	24
132	36·9	24
132	38·2	30
94	37·2	24
100	38	22
66	37	18
80	37	20
76	36·5	20
96	37	20
80	37	20
78	37·5	19
100	38	22
96	36	24
96	37	24
72	36	18
66	36·5	18
88	35·2	18
90	37·1	20

Many of the patients presented the septic condition so often observed in cases of chronic empyema. Icterus was observed in only three or four cases. In the larger abscesses there was an absence of symmetry with bulging in the lower intercostal spaces of the right side. In eight cases distinct swelling was observed in the epigastric region and in five cases in the right side of the abdomen, in one case as far down as the right iliac region. In one case there was a rupture of the abscess on the chest wall with a large ulcer and in still another a sinus opening at the umbilicus.

Enlargement of the liver below the costal margin could as a rule be detected by palpation except in the cases accompanied by much ascitic fluid. Deep fluctuation was obtained in ten cases.

SPECIAL SIGN

There is one sign to which I wish to call special attention as a help in diagnosis. This sign is deep-seated pain in the region of the abscess elicited by a sudden thrust with the end of the finger. We usually begin with the unaffected side to accustom the patient to this stroke. The most common point at which this sign appeared was the ninth interspace, about 2 inches from the right costal border. This sign has been almost constant.

With few exceptions (the small abscesses)

Fig. 1. Liver abscess. Area of dullness in a large single abscess.

Fig. 2. This patient suffered pre-operative necrosis of the ribs. Operation in 1916. Photograph taken in 1919. Patient seen in May, 1922, and was still in fine health.

Fig. 3. Photograph taken before operation. Area of dullness painted with iodine. Abscess ruptured into abdominal cavity and walled off.

Fig. 4. Photograph 3 weeks after operation, illustrating case with double incision. This was the oldest patient in the entire series—age 53.

percussion revealed an increase in liver dullness, most frequently upward, so that at the nipple line the curve of dullness began to rise and often reached the fifth and at times the third rib in the mid-axillary line, and the angle of the scapula, posteriorly.

If the above symptoms are found in any one case the diagnosis would be simple, but at times the onset of the disease is insidious and such cases may be devoid of special symptoms on entrance to the hospital. We have already shown how misleading the pulse, temperature, and respirations may be. An important factor in diagnosis is a mental attitude of suspicion which should prevail in the mind of the physician who is located in a region where amœbic dysentery is common. We attribute many of our findings to this attitude of mind.

With the coming of Dr. Hopkirk to our X-ray department we are finding help in diagnosis through this means.

TREATMENT

Prophylactic treatment. L. Rogers (8), in closing his lectures on amœbic liver abscess stated: "Amœbic or tropical liver abscess is an easily preventable disease in the great majority of instances and the occurrence of amœbic suppuration in the liver should cause serious question in the mind of the medical man in whose hands it has been allowed to develop." Our experience would bear out this statement for we have never seen a liver abscess develop in any foreigner or Korean who has been under the care of the staff of this institution. The early and energetic treatment with emetine together with the other measures usually employed in amœbic dysentery should be almost specific against liver abscess. All of our cases have come to the dispensary or hospital with well-developed and for the most part long-standing abscesses. These, of course, necessitate some form of operation.

Operations. Among the operative procedures advocated for abscess of the liver are the following:

Aspiration method. This may be done by means of a trocar and cannula with a rubber tube for drainage. This method was used with success by Manson. Some of the disadvantages are: (1) Open operation frequently has to be resorted to after aspiration has failed. At times, however, this is not a great objection for the patient may in some cases be relieved

and gain strength. (2) Difficulty of retention of tight-fitting cannulas or stiff rubber tubes, on account of the constant movement of the liver. (3) The pus is sometimes not discovered by aspiration or may be too thick to flow through the cannula.

Treatment by aspiration together with the use of emetine seems to promise good results; at least some of the late reports would so indicate. De Bellard (9), in the *Cacete médica de Carácas*, February 15, 1919, reported two cases of liver abscess treated before operation with subcutaneous injections of 0.04 grain of emetine morning and evening for 4 days. He then aspirated the contents of the abscess and injected 0.15 grain of emetine in 30 cubic centimeters of distilled water into the abscess cavity. Both cases are reported cured.

L. Rogers (8), in the lecture above noted, states: "In patients coming first under observation with an already formed amœbic abscess, whenever possible, the treatment of choice should be repeated aspiration and subcutaneous injection of emetine in preference to incision, while when such an abscess has eventually to be opened some form of sterile syphon drainage should be used. A little over a decade ago liver abscess was second only to typhoid in its lethal effects on the British soldiers in India, causing nearly 100 deaths a year among them but the death rate has already been reduced to one-sixth by the method Rogers has advocated." In our first two series (60 cases), we resorted only to operation by the open method although in many cases, perhaps a fourth, subcutaneous injections of emetine were used.

In 1919 we tried two cases by the method advocated by De Bellard. In the first case we were able to obtain only a small amount of pus by aspiration—about 200 cubic centimeters. Later we operated and evacuated 2,000 cubic centimeters of very thick pus. In the second we aspirated 300 cubic centimeters of pus, but had to operate 4 days later and obtained 1,000 cubic centimeters of very thick pus. In neither case did the emetine seem to thin out the pus.

Since my return from furlough we are trying again the aspiration method in cases not in this series, with promise of good results.

Method of approach through abdominal incision. In this operation as usually performed, incision is made in the epigastric region or right rectus, the liver is fixed to the abdominal wall by rows of sutures through its capsule and the peritoneal covering, to the edges of the abdominal incision. The opening is maintained by packing, and the incision of the abscess delayed 24 to 48 hours. The disadvantages of this method are: (1) two operations are necessary; (2) drainage is not so good; (3) the stitches are liable to pull away and infection of the abdomen may occur.

Transthoracic method. In his book on *Tropical Medicine*, Jackson (10) writes: "If there is bulging between the ribs we may expect the abscess to have for its coverings the diaphragm and the pleural layers. These will require stitching together in order to prevent the escape of pus into the pleural cavity. A resection of one or two ribs must precede this stitching. This done the abscess may be opened by an incision through pleura and diaphragm. Deep-seated abscesses should rarely be approached in this way as the steps of rib resection, uniting the diaphragmatic and the parietal pleural layers, anchoring of the liver to the wound and incision of the hepatic peritoneum, are all preliminary to the search for pus within the liver substance. The situation of the liver at the bottom of a deep recess, its movements to and fro unite to make this a deservedly unpopular operation."

The point of election for the large majority of our operations has been the ninth rib, about 2 inches from the costal margin on the right side. At this point the pleura is rarely encountered and we have found the technical operative difficulties mentioned by Jackson not at all troublesome at this site.

The writer's general plan. We believe that each case of liver abscess must be treated according to the findings and that no hard and fast rule can be made for every case. The following, however, may be given as the general plan which we have used in most cases.

A preliminary treatment by emetine subcutaneous injections of 0.06 grain is given daily for 2 to 4 days provided the patient's condition will permit of that much delay. During this

time we also deal with the intestinal parasites so frequently present.

In our first two series, the aspirator was employed for diagnosis only and used when the patient was brought to the operating room and all was in readiness to proceed with the operation. Many cases have been aspirated for diagnosis before coming to our service and we are inclined to put less emphasis than formerly on the dangers of aspiration.

We usually give a preliminary dose of morphine, 0.06 grain. The aspirator is inserted under local anæsthesia. If the patient's condition is serious it is wise to attempt the operation under local anæsthesia. Local anæsthesia (novocaine ½ per cent) with gas and oxygen would be ideal, but we have no means as yet of using gas anæsthesia. Only positive findings with aspiration are of value. In certain cases where the existence of an abscess is strongly suspected, we have operated after failure to obtain pus by aspiration and have each time evacuated a large abscess filled with thick pus. Lately when the diagnosis has seemed certain we have operated without use of the aspirator for diagnosis.

If a general anæsthetic is necessary, ether is preferable and must be used with great care and as little as possible must be given.

Incision of election. The incision is made parallel to the ninth rib, beginning about 2 inches from the right costal margin and extending outward. A portion of the rib 2 or 3 inches long is resected, the diaphragm incised, and the liver exposed. A small incision is made in its capsule, blunt scissors are inserted into the abscess cavity, and the wound is enlarged by opening the scissors and drawing them out. During this last procedure the patient is turned a little to the right. As soon as the cavity is opened the first finger of the left hand of the operator is inserted, and the liver held close to the wall while the pus is allowed to escape. After most of the pus has been evacuated, the first finger of the right hand may be inserted into the cavity and search made for any other compartments of pus or large masses of thick pus scooped out. When we first began to operate upon these cases, an attempt was made to sew the liver to the parietal peritoneum. The stitches would frequently tear away even before the operation was finished. We gave up this procedure and found no ill effects resulting. In only a few cases did we ever encounter the pleura, and this was easily sewed with no bad results. After most of the pus is evacuated we pack the cavity with gauze which is left undisturbed for 2 days. After this the abscess is drained with a rubber tube and gauze. We have used both Dakin's and hypertonic saline solutions for irrigation. Neither solution has hastened the healing to any marked degree. Dakin's solution does, however, dissolve the thick pus and make it run out easier.

We continue the injections of emetine (0.06 grains daily) for 4 days after operation or a week or more longer if there are symptoms of active dysentery. We have also used tri-methol as an intestinal antiseptic.

In large abscesses, after the pus has been evacuated and the liver begins to contract, the drainage has at times been interfered with by the changed position of the liver. It is necessary to keep a good opening for drainage. If this is left to an assistant, unless he is well instructed, he is apt to allow the external opening to close too quickly. In three cases the ends of the divided ribs became infected and required secondary operation. We now cover the ends of the divided rib with periosteum.

Abdominal incision. In cases where the abscess has ruptured into the abdomen, in our series, the operation consisted of drainage at the lowest point, even though it required a second incision. Where the abscess has not ruptured but the liver projects into the epigastric or hypochondriac region we have proceeded according to the method mentioned above in "The Approach through the Abdominal Incision," except that we have opened the abscess at the time of the operation. In several cases we have combined the abdominal incision with that of the ninth rib (see Fig. 4).

MORTALITY

Most of the mortality reports of liver abscess are high.

Manson (4) records the mortality of liver

abscess as follows: "Rouis (203 cases) in Algiers observed a mortality of 80 per cent; Castro (125 cases) in Egypt, a mortality of 72.5 per cent or excluding cases operated on, of 76 per cent; in the Indian army during the period 1891 to 1894, prior to which abscess of the liver, in the statistical report is not separated from hepatitis and presumably included cases operated on, the mortality was 57.7 per cent."

Rogers (8) reports: "Among British troops in India for 15 years from 1894 to 1908 the fatalities averaged 56 per cent." The mortality as worked out by Rogers shows 73.4 per cent of those operated upon through the chest wall, 46 per cent through the lungs and 40 per cent through the abdomen. Cantlie (100 cases) using the Manson method of aspiration and drainage has a mortality of 18 per cent. Rogers reports 14 per cent mortality in 21 cases treated by aspiration and quinine injections. Lately Rogers in the lectures above quoted says: "The death rate among British soldiers in India has been reduced one-sixth by the method of aspiration and injection with emetine."

The mortality of our series is as follows:

In the first series (30 cases) there were four deaths (13.3 per cent).

In the second series (30 cases) there were three deaths (10 per cent).

In the third series (40 cases) there were three deaths (7.5 per cent).

The mortality for the combined series of 100 operations was ten deaths or 10 per cent.

The following may be noted in the fatal cases:

Case 1. Male, age 23 years. Previous to operation rupture of abscess in pleura and abdomen. Albumin in urine. Hookworm.

Case 2. Male, age 30 years. Rupture in pleura. Pulmonary tuberculosis.

Case 3. Male, age 31 years. Active amœbic dysentery. Rupture of abscess into abdomen before operation. Ascites present.

Case 4. Male, age 26 years. Large abscess of 3,000 cubic centimeters. Rupture into abdomen. Hookworm.

Case 5. Male, age 30 years. Rupture into abdomen. Active dysentery.

Case 6. Male, age 41 years. Large central abscess, case complicated by active dysentery, ascites, and pleural effusion.

Case 7. Male, age 46 years. Patient was so ill that no history was obtainable. At first it was difficult to determine whether he had a chronic empyema or liver abscess. There was a fistula leading down to the eighth rib in the right posterior axillary line. Upon operating we observed that a portion of the seventh and eighth ribs for a distance of 5 centimeters was necrosed and that the ribs had spontaneously fractured. Beneath was a large abscess cavity extending from the third to the tenth rib. It was only after excision of a portion of the abscess wall and microscopical examination of the tissue that we were able to arrive at a positive diagnosis of liver abscess.

Case 8. Male, age 38 years. This patient was in critical condition upon entering the hospital being a victim of the morphine habit. He left the hospital before permission was granted, and we feel sure that he could have lived but a short time so include him in the mortality list.

Case 9. Male, age, 30 years. Rupture into the pleural cavity.

Case 10. Male, age 28 years. Patient very weak on admission to the hospital. His temperature was markedly subnormal, below 36 degrees C. The abscess was a large one and had ruptured into the pleural cavity.

SUMMARY

1. Although Korea has a temperate climate, both amœbic dysentery and amœbic liver abscess are common among the Koreans.

2. While amœbic dysentery is common among the white population, amœbic liver abscess has not been observed.

3. Liver abscess is infrequent before the age of 20 years. The average age of our series is 30 years.

4. The incidence of liver abscess in Korean females is 8 per cent—a larger percentage than that reported in other countries.

5. The large single abscess of the right lobe of the liver predominates.

6. Liver abscess develops as a rule insidiously. A large abscess may be present with normal pulse, temperature, respirations and blood count.

7. Deep-seated pain in the region of the abscess elicited by a sudden thrust with the end of the finger is an important and practically constant sign.

8. The early and continued treatment of amœbic dysentery with emetine will prevent liver abscess in most instances. We have seen no case of liver abscess develop in Koreans or foreigners thus treated.

9. Although we have operated upon all of our cases by the open method, yet if the pus flows well on aspiration late reports of other observers indicate that this method together with the injection of emetine should be tried. Our late experiences not reported here give promise of good results by this method.

10. Keep a mental attitude of suspicion of the possibility of liver abscess in localities where amœbic dysentery is prevalent.

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RUPTURE OF THE LIVER

With Report of a Case in Which Autotransfusion was Employed

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TRAUMATIC rupture of the liver is probably much more common than reported cases would indicate, as lacerations without distinctive symptoms pass undiagnosed and are included under the general caption of shock. While it is often associated with injuries in which a vehicle passes over the body, serious damage may be done the liver by seemingly mild violence, and rupture of the liver without fracture of a rib is fairly common. There is no constant relation between the trauma, as noted in the history and the clinical symptoms; nor does the damage to the overlying ribs or integument furnish grounds for a reliable diagnosis.

The symptoms are those of acute internal hæmorrhage plus trauma in the liver region. The hæmorrhage may be of such violence that death results speedily, or may be so slight that it is not distinctive and remains undiscovered. Rupture of the liver may be attended with rupture of the stomach or intestine, and the symptomatology may have all the aspects of peritonitis, with the liver lesion in the background. The outstanding features are those of acute hæmorrhage, and its blood picture, with history or evidence of trauma in the anterior, lateral, or posterior aspects of the right chest. If the amount of blood that has escaped has been large, there may be physical signs of fluid in either flank.

In the case herein reported, we aspirated the peritoneal cavity with a large needle, and we are of the opinion that the procedure is safe and of considerable value, although it does not exclude the diagnosis of a traumatic perforation of the intestine or stomach.

The difficulty lies in determining if shock alone exists, and while theoretically the distinction between shock and hæmorrhage may be clear, practically the diagnosis may present obstacles which cannot be surmounted in the brief time that the exigency permits. The blood examination loses some of its value should an anæmic individual be the victim of an accident, provided no previous examination of the blood has been made. Aspiration of the peritoneal cavity is most helpful in determining if we are dealing with shock or with hæmorrhage from the liver.

Many cases of even severe hæmorrhage following rupture of the liver survive, because spontaneous arrest of the bleeding may occur, and those patients who survive the injury 3 days, usually recover. We do not look upon hæmorrhage from the liver as of an infective nature, but the possibility of infection from this source must be reckoned with. There is sufficient proof of the presence of organisms in the portal circulation and in liver bile, and pouring out of bile and blood into the peritoneal cavity from a traumatized liver is not

without risk of peritonitis. The actual occurrence, however, is rare.

In the severe hæmorrhage, the operative abdomen is so manifest that there is rarely any hesitancy in exploring. In the milder types it is not easy to decide whether to depend upon spontaneous arrest of hæmorrhage or to adopt the more active course. We are guided in these cases by the frequent blood examinations and pulse rates. It may be difficult to eliminate the possibility of visceral rupture, but we believe that vomiting is more conspicuous and the leucocyte count is higher in perforation than hæmorrhage. Rigidity and tenderness are not valuable as early signs, and the condition must be recognized early if we expect a successful issue. Between rupture of the liver and a contusion of the chest or abdomen, the differential diagnosis lacks the textbook character. Blood examination every hour with especial reference to the hæmoglobin and red cell count is the most reliable. The specific gravity of the blood is of doubtful service and the leucocyte count is in no sense pathognomonic. Rigidity, tenderness, and vomiting may be present in both. Sufficient free blood in the peritoneal cavity to give physical signs places the case in the class of severe hæmorrhage, and its recognition by the blood examination and subjective symptoms is usually made. We believe the more general use of the aspirating needle would prove dependable in those cases where the hæmorrhage is not great and the diagnosis rests between shock and mild hæmorrhage. In any case of doubt, the mortality will be less if an exploration is made rather than to wait for developments.

The actual control of hæmorrhage from the liver is attended with many difficulties, among which are inaccessible or deep lacerations, stellate lacerations, and the friability of the liver. Lacerations which can be reached by a suture are best closed by sutures which first parallel the torn surface, and these in turn are used as stanchions behind which other sutures are carried and cross the fissure. The parallel sutures of catgut give a stability which the liver alone does not possess. Lacerations difficult or impossible to suture may be packed with gauze, cauterized with a blade, or, better yet, brought together by packs placed against the liver. Drainage of the region of the liver should always be instituted.

The following case presents some usual and unusual features of rupture of the liver.

J. B., colored, age 18, chauffeur by occupation, was admitted to the Emergency Hospital at noon, November 29, 1920, for a contusion of the abdomen following a fall over a concrete frame.

His family and previous history are unimportant.

When admitted to the emergency service, he was treated for a contusion of the right chest and shock, and after remaining in the rest room 7 hours, he was sent to the ward. The record shows that at 7:45 p.m., while in the ward, his pulse was 136, respiration 18, and temperature 95.6. He was given caffeine-sodium-benzoate and morphine sulphate. His condition evidently did not excite interest or attention, for he was not seen by an interne until 8:30 a.m. the following day. He was given morphine and an enema and expelled some gas. At noon his pulse was 140, respiration 36, and at this hour we were called to see him and found the patient in a state of collapse, a tender abdomen, with slight dullness in both flanks and a systolic blood pressure of 83. The urine showed a trace of albumin and a few granular casts. He was evidently suffering from an internal hæmorrhage, but whether it was complicated by rupture of the stomach or intestine was the question, but the absence of vomiting favored the diagnosis of internal hæmorrhage only.

A medium sized needle on a large hypodermic syringe was used to aspirate the left flank, directing the patient to turn to the left side to promote any fluid present to gravitate in that direction. Plunging the needle through the abdominal muscles, it could be felt to pass into a non-resisting area and, upon withdrawing the piston, the syringe was filled with blood. A portion of this was placed on a slide for examination and a culture made from the remainder, which subsequently proved to be sterile. The slide showed no change in morphology of blood cells.

A blood examination was made and reported as follows: red blood cells 2,800,000; white blood cells. 17,000; hæmoglobin (Dare) 45 per cent.

The Murphy drip was started at once and hemoplastin administered by hypo. He did not retain the drip very well and frequently removed the tube, appearing slightly delirious. He seemed to be growing progressively weaker. His pulse at 6 p.m. was 146 and of poor quality. It was decided to transfuse him before opening the abdomen, but we were unable to obtain a donor until 7 p.m., and the only voluntary donor of his type was his aunt. Five hundred cubic centimeters of citrated blood was introduced by the indirect method, and immediately thereafter the abdomen was opened. The peritoneal cavity was literally filled with liquid blood. Much

of this was aspirated into a sterile jar, into which had been previously placed 60 cubic centimeters of 2 per cent sodium citrate. No wound could be found in the stomach or intestines. A long, deep laceration could be distinctly felt in the dome of the right lobe of the liver, immediately beneath the diaphragm and evidently the source of the hæmorrhage. This was packed with gauze and, as there seemed to be no contamination of the blood withdrawn from the abdominal cavity, we decided to transfuse the patient with this blood, and used the vein in the right elbow for this purpose, introducing 500 cubic centimeters. The patient left the operating room in fair condition, all things considered, but spent a restless night and once got out of bed. During the following week his pulse varied from 100 to 146 and his temperature from subnormal to 102°. About this time we learned that the donor had a 4+ Wassermann and that the recipient was negative. Wassermann tests were made weekly during the next 3 months and all were negative, although no antisyphilitic treatment was instituted. The packing was removed from the liver on the eighth day under gas anæsthesia.

Two weeks after admission his temperature showed extensive excursions and a physical examination indicated fluid in the right pleural cavity. An X-ray report, under date of December 16, states: "The diaphragm on the right side is elevated and immobile. There is a moderate amount of fluid in the right pleura. There also appears to be a second fluid level below the dome of the diaphragm with a small collection of gas above. The appearance of the latter is strongly suggestive of a subphrenic collection of fluid, possibly a subphrenic abscess."

The right pleural cavity was aspirated, withdrawing bloody fluid (apparently unadulterated blood), a tube inserted through the cannula, and the Mozingo method of irrigation used. A culture of the fluid showed no growth. Frequent irrigations of the cavity soon reduced its contents and allowed expansion of the lung. On December 27, the roentgenologist (Dr. Groover) reported the fluid in the chest almost absent, but a very definite collection of fluid and a gas bubble between the right lobe of the liver and the diaphragm. The irregular temperature continued and on January 7, after aspirating posteriorally between the diaphragm and the liver and obtaining a foul, bloody liquid, we introduced a small drainage tube and irrigated this space several times daily. A culture of the fluid showed the Friedlaender bacillus. The temperature continued to oscillate and his general condition was not good, having become much reduced in weight and strength. The pulse rate ranged from 106 to 120.

The X-ray report of January 14, 1921, states: "The subdiaphragmatic fluid level is somewhat lower than at previous examination. The gas bubble between the fluid and the diaphragm appears somewhat larger and the cause of the gas bubble is not definitely understood."

On January 31, the opening between the liver and the diaphragm was much enlarged so that the finger could be introduced. A large quantity of old clots, or degenerated liver substance, was removed. At this time gas escaped also. Microscopical examination of the débris showed that the mass had undergone hyaline degeneration and no cellular arrangement could be seen. The following month there was no appreciable change in his condition; there was a variation of about four degrees daily in his temperature, his pulse averaged about 112, his urine contained albumin and the leucocyte count was usually between 12,000 and 15,000. Beginning March 1, after all wounds were closed and no fluid could be obtained from either the thoracic cavity or beneath the diaphragm, his condition improved, and he was allowed to get out of bed about the middle of the month. He then weighed 85 pounds. His pulse finally remained less than 100, his temperature was never above normal, and he was discharged March 19, or about three and one-half months after admission. His Wassermann was negative March 15, and the only blood culture made was negative. On April 27, he weighed 125 pounds, a gain of 40 pounds since March 15. He stated that he was in perfect health.

The direct and indirect methods of transfusion are common therapeutic methods, but the so-called auto-transfusion, by which is meant the patient's own blood, lost by internal hæmorrhage, is introduced into his circulation, has been seldom employed and the literature contains little information regarding it.

Thies (1), a German gynecologist, is given the credit of first employing auto-transfusion clinically, and in his report in 1914, he cites three cases of extra-uterine pregnancy in which he baled blood out of the abdominal cavity, mixed it with salt solution and injected it into the veins of his patients. All recovered. Other German operators have taken up this method, and reports have been published by Eberle (2), Henchen (3), Lichtenstein (4), Burgkhardt (5), Friedemann (6), Kreutor (7), Kulenkampff (8), Schafer (9), Schweitzer (10), the latter in June, 1921, citing twenty-one cases in which he reinfused the patient's own blood. We have not found in American or English literature any reference to this method.

The blood for such purposes is usually found in the abdominal cavity as the result of rupture of the liver, spleen, or uterus, injury to the mesentery, or extra-uterine hæmor-

rhage. One operator has used blood from the pleural cavity, but this source, as well as that from the uterus, seems hardly justifiable owing to the probability of contamination. Blood, to be used for this purpose, must be above suspicion in so far as infection is concerned. It has been stated by competent observers that during health, the liver blood frequently holds pathogenic organisms in suspension.

Blood which has disintegrated loses many of its desirable qualities, and it has been noted that the older the blood, that is, the longer the period after hæmorrhage, the less its value as a transfusion agent. In the peritoneal cavity, blood retains its morphological character much longer than the same blood exposed to air. The clotting of blood interferes physically as well as chemically in its adaptation for this purpose. The clots, however, can be strained and washed, so that they are not a total loss.

In removing blood from the peritoneal cavity, in the early report of cases, sponges were dipped into it and wrung out over a receptacle containing salt solution, or a solution of sodium citrate. Later, a ladle or spoon was used for the same purpose. We found that the Balfour aspirator was ideal, permitting a thorough and quick method of obtaining it, and we do not agree with the statement that the aspirator traumatizes the blood more than the slower ladle method. The motor or hydraulic aspirator certainly accomplishes the same result in less time, with less injury to the viscera and more completely than can be done in any other way.

We have proceeded in the following manner: As soon as the abdomen is opened, having previously sterilized all parts of the aspirating outfit which come in contact with the blood, and having placed 50 cubic centimeters of 2½ per cent of sterile citrate of soda solution in the receptacle; the nozzle of the aspirator is introduced into the peritoneal cavity and the blood removed. If more than a pint is obtained, a second cubic centimeter of sodium citrate is added to the container. An excess of citrate does not appear to be harmful. The source of the hæmorrhage is found and receives appropriate surgical treatment. If a ruptured intestine is found, or any gross contamination of the blood is seen, the blood cannot be used. The citrated blood is then poured through gauze into the infusion outfit and introduced into a vein of the arm by an assistant without interrupting the operation. We have used from 500 to 700 cubic centimeters of blood, believing that a larger quantity is not without danger of embarrassing the heart, although Kulenkampff infused 2¼ liters. We have obtained more than 1,000 cubic centimeters of blood from the abdomen and have been almost reluctant to discard the excess over 750 cubic centimeters. It may be possible, although we have never done so, to refrigerate the blood from the abdomen and keep it in reserve for that particular patient from whom it was removed, or for any other suitable case. It has always appeared a needless waste to see 500 to 1,000 cubic centimeters of blood removed from the abdomen and emptied into a bucket of soiled sponges.

Reactions following transfusions, irrespective of the methods, are not dissimilar, the chief characteristics being a chill, rise of temperature, and aching of the back and limbs. The percentages of reactions in transfusions vary greatly according to the various reporters, apparently depending upon the technique, typing, and condition of the recipient. One reaction in every 2 to 5 cases has been recently reported by Bernheim. We had two reactions in 6 cases of autotransfusions. Whether these reactions were due to the blood re-infused, which had undergone some change, chemical rather than physical, or the additional stress of the operation the patient must bear, are conditions which have not been apparent, and as far as we know, have not been investigated. A patient with a traumatized abdomen, with acute excessive hæmorrhage, cannot be compared from the standpoint of reaction, with the case in which transfusion is commonly done. We can simply state that in our brief experience the reaction in autotransfusion is more frequent than in other methods.

Autotransfusion is indicated in active hæmorrhage in the abdomen, of such gravity as to jeopardize the life of the patient if no

other means are at hand to supply the blood. Contamination of the blood in any manner, either by nature of the injury or in preparation of the blood, contra-indicates its use. Extra-uterine pregnancy would seem to be the ideal indication for auto-transfusion and has been the most frequent condition in which it has been used. Better diagnoses have reduced measurably the mortality in ectopic gestation and the necessity for transfusion is infrequent, but when the necessity does arise, the larger hospitals and communities are usually able to supply a donor on brief notice.

The best laid plans go astray at times and likewise the diagnosis. It is when the ruptured tube with the hæmorrhage is unexpected or the picture moves with unusual swiftness that auto-transfusion is an agency that meets the requirements. Rupture of the liver, spleen, gunshot wound of the mesentery, the volume of hæmorrhage, the call for speed, the delay in obtaining a donor, justify the use of auto-transfusion. We feel that blood from a ruptured uterus, or from the pleural cavity, should not be used for this purpose, although some operators have done so.

Aside from the gratifying recovery of the case reported above, it has been a source of much interest, and several features are worthy of consideration:

1. Aspiration of the peritoneal cavity for diagnosis seems a perfectly rational, safe, and valuable method at our disposal. Puncture of the intestine by such procedure is attended with more theoretical than real danger. We have only to recall with what facility and security the roentgenologist employs the needle in the pneumoperitoneum X-ray photography to verify this.

2. Auto-transfusion (or re-infusion) has a limited field of application, but when indicated is a great aid in serious emergency. It seems free from risk. We have repeated it five times successfully since this case came under our observation.

3. The introduction of blood of a syphilitic into the circulation of a patient free of this disease does not necessarily transmit the disease. This is not a new observation, but confirms other clinical reports.

4. We account for a sterile fluid in the abdominal cavity at operation, sterile fluid in the pleural cavity, and a fluid containing Friedlaender's bacillus between the liver and diaphragm by infection through the portal vein. The gas bubble between the liver and the diaphragm, which was removed by free drainage and did not recur, was probably due to infection by the Friedlaender bacillus.

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FUNCTIONAL LIVER TESTS

An Experimental Study

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IF the recent prominence which has been given the subject of non-surgical biliary tract drainage in medical literature by Lyon, Smithies, Einhorn, and others has done nothing else, it has served to emphasize the ease with which duodenal intubation may be accomplished, and this in turn has stimulated a revival of interest in what is still generally considered to be a closed chapter in the history of the liver and duodenum, the question of an hepatic functional test.

In theory, at least, a procedure for such a test is at once suggested which does not look impossible. The most evident function of the liver lies in its ability to excrete bile, just as the kidneys excrete urine. In the renal functional test of Rountree and Geraghty the urine is collected for us by means of the urinary tract. In the case of the liver, the optional procedure would appear to be to collect the bile through a duodenal tube. In the renal test a dye, phenolsulphonephthalein, is employed, and the basis of the test lies in the amount of the dye which the kidneys are able to excrete in a given time. The investigations of Abel and Rountree have called attention to a dye, phenoltetrachlorphthalein, which might be of similar use in an hepatic functional test. The inference, then, is that given a duodenal tube, which may be passed into the duodenum under the precautions prescribed by the Lyon-Meltzer method of biliary tract drainage, a magnesium sulphate solution to irrigate the duodenal mucosa and relax the common duct sphincter, and a dye which is known to be excreted by the liver in the bile, why should not an hepatic functional test be evolved, in which the amount of phenoltetrachlorphthalein recovered over a given interval of time shall be an index of biliary efficiency?

Immediately, however, a host of objections, real and otherwise, suggest themselves. For instance, would the excretion of so much dye over a certain period of time in the outflowing bile be a measure of the function of the liver? The production of bile is not the sole task of the liver; certainly it is doubtful whether such a determination of dye output would be a measure of damage to liver tissue. On the other hand, if a dye like phenoltetrachlorphthalein was found to be as reliable in liver disease as phenolsulphonephthalein seems to be in renal function, it is at least not unreasonable to assume that a lowered phenoltetrachlorphthalein output might represent a comparable degree of pathological change in the liver substance.

Another objection would arise, about which is centered much of the controversy regarding the Lyon-Meltzer drainage, and that is whether or not, following the irrigation of the region of the papilla of Vater in the duodenum with a magnesium sulphate solution, the gall bladder completely empties itself of its contents, the "B" bile of Lyon, so that the lighter colored "C" bile which follows represents pure liver bile. As we see it, one of the prime necessities of such a functional test must be that the bile collected for quantitative determination of its dye value shall be liver bile alone, and any admixture with contents from the gall bladder, or, for that matter, from the stomach or the duodenum itself, would vitiate the results. Hence, if, as Lyon assumes in the general run of cases, the gall-bladder contents are promptly and completely expelled in the A B C sequence following irrigation with the magnesium sulphate solution, so that the "C" fraction represents true liver bile, then this objection may be overruled. If, on the other hand, the "B" fraction does not represent but a variable portion of the gall-bladder contents, then any estimation of dye per unit volume of bile is in error by just so much as there is static bile delivered into the duodenum from the gall bladder during the course of the drainage.

Further objections regarding the mixing of stomach contents or of pancreatic and intestinal fluids with the discharging bile may be minimized by the thorough lavage of the stomach and duodenum prior to the injection of the dye.

Again, though to a much greater degree than in the renal test, the question of the interference of pigments with the colorimetric readings of any dye arises. Dilution gets around this difficulty in the renal functional test, but the bile pigments are not so easily disposed of, and the decolorization of bile without loss of dye represents one of the most difficult problems in essaying a quantitative determination of liver function.

Add to all these the almost certain knowledge that it is not possible to siphon over or to obtain through suction all of the duodenal contents during the course of a prolonged biliary drainage, the uncertainty of position of the tip of the duodenal tube without fluoroscopic facilities, the tendency of the tube to become clogged with extraneous material, and the great amount of individual restlessness and vagaries that crop out in a patient during such an extended procedure, and the problem which on the face of it looked simple becomes very complicated.

Following the initial work of Rountree, Whipple, and others in the use of phenoltetrachlorphthalein in a burdensome hepatic functional test involving the collection of the patient's stools for a period of 48 hours, and that of Einhorn and others in the use of the duodenal tube, but prior to the time when the Lyon-Meltzer method of biliary tract drainage began gaining prominence, McNeil undertook some investigations regarding the use of phenoltetrachlorphthalein and the duodenal tube for a liver functional test. He noted the time of appearance of the dye in the bile following its intravenous injection and the amount recovered in 2 hours. He wrote that the quantitative estimation of the dye in the duodenal contents was easily done in the same way as in the renal functional test, provided the estimation was done promptly following the collection, a statement to which we are unable to subscribe as the result of our investigations. Simply adding sodium hydroxide to even a much diluted specimen of bile did not in our experience nullify the interference of the bile pigments to a sufficient degree so that we could compare such a specimen, containing phenoltetrachlorphthalein, with a standard aqueous solution of the latter. However, McNeil came to the conclusion that the quantitative determination of the dye in the duodenal contents was of little value, a conclusion similar to that to which later workers have come.

In a series of 25 cases, we attempted to carry out biliary tract drainage and, for the sake of uniformity, we endeavored to follow the procedure outlined by Lyon exactly, but with the additional view in mind of following it up with a functional test. This consisted of waiting until the flow of the "C" fraction of bile was established, then injecting 50 milligrams of phenoltetrachlorphthalein intravenously and collecting all the bile possible during the succeeding 2 hours. In some of the more favorable cases, the typical "C" bile which Lyon describes was obtained from the duodenal tube in a fairly consistent way over such a period. On the other hand, in perhaps half the cases, for one reason or another, the flow would stop before 2 hours had elapsed, so that nothing else could be obtained from the tube without again irrigating the duodenum with the magnesium sulphate solution, a procedure which at once introduced the elements of dilution and possible gall-bladder content contamination, and thus made any comparison of the dye content of the bile with other determinations out of the question. We are familiar with the explanation which Lyon has put forth for these cases where repeated stimulations are necessary, but in some of these cases to which we refer, there was assumed to be no pathological change in the gall bladder or liver, an assumption later verified at laparotomy. Or, perhaps the tube would become obstructed and then before the obstruction could be removed, one could be sure that some of the duodenal contents had escaped down the jejunum. Furthermore, the position of the tube in the duodenum could not be accurately determined without losing part of our 2-hour period and, as Johnson has shown, siphonage or suction with the

tube tip above the papilla of Vater results in a loss of duodenal contents downward, a thing which undoubtedly, from the variable nature of our collections, occurred more than once in our series of cases.

The output of phenoltetrachlorphthalein varied greatly even in those cases in which the drainage went the smoothest. In one man no phenoltetrachlorphthalein could be demonstrated in his bile over a period of 10 days. He had a cholecystectomy for common duct and gall-bladder stones, and the determinations were attempted on the post-operative bile which drained from a tube left in the duct following the operation. At operation the liver presented no gross pathological change which could account for such a result. Microscopically, there was some increase of periportal connective tissue. The conclusion had to be drawn from this, and other cases, that there was no reasonable normal output of dye per unit of bile and time, and that on the contrary the range might be from practically nil to as high as 4 per cent in an hour. At first glance, this is not a wide variation, but in a quantitative determination of the dye, one deals with graduations of a tenth of a milligram or less, so that the range after all is too great for use. It is unfortunate that the major portion of an injection of, let us say, 50 milligrams of phenoltetrachlorphthalein is not excreted in an hour or two in the bile, as is the phenolsulphonphthalein in the urine of a normal individual, but such is the case, and this increases the difficulty of any quantitative determination.

In arriving at our quantitative values we found early that simple dilution of the collected bile with the addition of sodium hydroxide did not give us a solution which could be compared either grossly or more accurately in a Duboscq colorimeter. Accordingly, one of the first steps was to find a way of removing the bile pigments without removing the phenoltetrachlorphthalein. The common precipitants such as lead subacetate, barium hydroxide, alumina cream, egg albumin with trichloracetic acid, and others were, in general, unsatisfactory. Lead subacetate or barium hydroxide will decolorize bile so that a water-clear filtrate can be obtained, but if enough of these salts is added to throw down all the bile pigment, the phenoltetrachlorphthalein is likewise removed almost entirely.

The following procedure is the one which we finally came to use in the determinations which we made in the series as the one which did away with most of the interfering pigments and at the same time threw down the least amount of the phenoltetrachlorphthalein:

Alkalinize to a moderate degree a unit volume of the freshly collected bile (we used 25 cubic centimeters as a unit volume) and add 10 cubic centimeters of a saturated solution of lead subacetate and 10 cubic centimeters of a normal calcium chloride solution. A precipitate forms which carries down with it most of the bile pigments. This is quickly and easily centrifuged at high speed, the clear supernatant fluid poured off, made up to 250 cubic centimeters with water, and compared in a Duboscq colorimeter with a standard solution, the concentration of which is near that of the unknown.

If we are correct in our assumption that there is no difference between the phenoltetrachlorphthalein that is excreted in the bile following its intravenous injection and that which we added to plain bile in order that comparison of known amounts of the dye in bile and in water alone might be made, then the margin of error of this procedure is within 5 per cent.

Investigation on dogs was later begun with two things in view: the first to attempt the Lyon-Meltzer biliary drainage on normal and on cholecystectomized dogs; and, second, the carrying out of an hepatic functional test on normal dogs and on dogs whose liver had been damaged, as by prolonged chloroform anæsthesia.

Five dogs were anæsthetized with ether and a small stomach tube passed and guided manually into the duodenum through a laparotomy wound. The duodenum was then irrigated with a 25 per cent magnesium sulphate solution. Peristalsis was promptly inhibited almost completely, but there was no apparent contraction of the gall bladder at any time. In all our dogs, either during

digestion or in the fasting state, the gall bladder always contained a considerable quantity of bile. The recovery of bile through the tube was variable, and not suggestive at any time of an A B C sequence. Five fasting dogs were given a preliminary anæsthesia with ether until chloretone by stomach tube had taken effect, and then laparotomy and duodenotomy were done, similar to the work of Auster and Crohn. We also injected a solution of methylene blue into the distended gall bladders, and then irrigated the duodenum with a magnesium sulphate solution. In these dogs an immediate discharge of bile from the duct opening was observed as the sphincter relaxed, but at no time was there even a suggestion of the bluish gall-bladder bile. It was noted in these dogs that this discharge of bile came in spurts which were synchronous with the respirations of the animal. Since, in the dorsal position in which these dogs were lying, the gall bladder with its darker and more viscid contents was always considerably lower than the common duct opening, we sought later in six dogs to enlist the aid of gravity and found that, if, after the duodenum had been lavaged with the magnesium sulphate solution, the upper part of the dog's body was elevated in order that the gall bladder could be brought slightly above the duct opening, and if care was taken to see that there was no tension or kink in the common duct in its passage through the wall of the duodenum, in most of the dogs we obtained a play of colors in the bile appearing at the duct opening suggestive of an A B C sequence. The same phenomenon was noted when methylene blue was injected in the gall bladder. These things seem to justify Johnson's conclusion that the specimen termed gall-bladder bile is in part the result of gravity.

In two of these dogs the cystic duct was clamped off and the bile from the other biliary passages compared with that of the gall bladder. In every case that from the gall bladder was a darker color and more viscid than the bile of the hepatic ducts.

On a cholecystectomized dog, observation of the cut opening showed more or less continual leakage of bile from that point, and after irrigation with a magnesium sulphate solution and the assumption of a semierect position, there was an increase in the flow of bile, but with no gross color change. No dilatation of the stump of the cystic duct or of the hepatic ducts was found at autopsy on this dog.

In four dogs in which phenoltetrachlorphthalein was injected intravenously, it was subsequently recovered in the duodenum in from 10 to 15 minutes after injection. When the cystic duct was left patent, the dye could be demonstrated in the gall-bladder bile. When the cystic duct was clamped off prior to the injection of the dye, none could be found afterward in the gall-bladder bile. These results are similar to those of Auster and Crohn.

At no time, however, could we keep the sphincter relaxed for a 2-hour period and collect liver bile over such a period, so that it was concluded that an hepatic functional test on dogs by a method similar to that used above on humans was not feasible.

CONCLUSIONS

1. That phenoltetrachlorphthalein is not a satisfactory substance to use in an hepatic functional test based on the quantitative estimation of its output in the bile.

2. That there are too many factors which tend to prevent a complete collection of liver bile by the duodenal tube to warrant its use in such a procedure.

3. That the so-called "B" fraction in a non-surgical biliary drainage is in part at least derived by gravity from the gall bladder.

4. That under ether and chloretone anæsthesia the sphincter of Oddi will relax, but that there is no contraction of the gall bladder sufficient to empty itself concomitant with this relaxation of the sphincter as viewed at laparotomy.

5. That the intermittent flow of bile from the common duct is probably the result of an increase in intra-abdominal pressure during respiratory movements, and that in all probability, as Harer et al have concluded, "the gall bladder is emptied of its contents by pressure of adjacent, distended, and congested organs during digestion and by the milking action of the duodenal peristaltic waves."

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HYDATID CYSTS OF THE LUNGS AND PLEURA

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HYDATID cysts of the lungs, occurring as they do, next in order of frequency to those of the liver, are of great importance. They are important, however, not so much because of their frequency as because of the very severe symptoms they produce, the complications to which they give rise, and the very serious errors of diagnosis to which they sometimes lead.

A hydatid cyst of the liver may exist for a very long time, grow to an enormous size, and still interfere but little, or not at all, with the health of the host. This is not true, however, with hydatids of the lungs. Almost from the beginning they may give rise to the most alarming and distressing symptoms, and their treatment is often a matter of great difficulty and danger. The most constant, and occasionally the earliest symptom of hydatid of the lung, is hæmoptysis, which may be great or trivial in amount. Next in importance is the cough, dry and hacking in character, and, in the early stages, unaccompanied by sputum.

In the lung, the development of the ectocyst is slight; hence rupture into the pleura or bronchi, or sometimes into both is common, and is generally fraught with great danger to the patient. Rupture into a bronchus is characterized by violent fits of coughing, cyanosis, sometimes very severe dyspnœa, invariably hæmoptysis, and, according to the size of the cyst, a greater or less amount of watery expectoration in which bits of membrane and daughter cysts are found and, under the microscope, hooklets may be discovered.

If the cyst content is not already infected when the cyst ruptures, it is sure to become so. The sputum turns purulent, hæmoptysis may be frequent and severe, hectic fever makes its appearance, and the great wasting and accompanying debility, together with the cough and sputum give the patient a typical appearance of advanced tuberculosis. Many cases have been erroneously diagnosed as such. Should the cyst rupture into the pleura, the symptoms closely simulate a pleural effusion; if the cyst is septic, an empyema. If not very carefully examined, large unruptured cysts at the base of the lung, easily mislead to a diagnosis of pleural effusion.

This much I think will show how difficult diagnosis is. I will endeavor to outline the points upon which a correct diagnosis can be made. In the first place, in any country where hydatids are known to abound, the occurrence, in an otherwise healthy person, of a dry hacking cough, with none or only scanty sputum, in which repeated examinations have failed to demonstrate tubercle bacilli or other cause, especially if there be a history of hæmoptysis, should always arouse one's suspicions of the possibility of hydatid disease of the lung. Physical examination of the chest will be fruitful or the reverse, largely according to the size and situation of the cyst. A small cyst, deeply situated, may give no physical signs at all, nor be visible in an X-ray. An examination of the blood may help. An eosinophilia is suspicious, and if the serum diagnosis of Ymaz Apathie or of Ghedine is also positive, the suspicion becomes almost a certainty. Still the case may be doubtful, and there is nothing to do but to have patience, waiting until such time as the cyst has developed to the point where diagnosis is a certainty.

If the cyst has attained a fair size, is not too deeply placed, has a circumscribed area of dullness, relative or absolute according to the amount of healthy lung tissue which intervenes between the finger and the cyst; if the breath sounds are diminished or absent, with sometimes signs of compression or of more or less acute congestion around the periphery; and if a round shadow shows on the X-ray plate, there is very little room for doubt as to the nature of the complaint, and an exploratory puncture which gives clear watery fluid, will confirm the diagnosis both as to the nature and the position of the disease. This latter procedure should be undertaken only with the patient prepared and everything ready to proceed with operation, so as to avoid a subsequent leakage of cystic contents, as sometimes the cyst content is highly toxic, or, what amounts to the same thing, some patients show a marked idiosyncrasy to it. Possibly, due to slight absorption, they have become sensitized. At any rate, serious complications have been known to follow and death has not infrequently occurred after simple puncture of a hydatid cyst; hence the necessity for exercising all due caution. Furthermore, secondary infection is almost certain to follow, with all its attendant dangers. Though hydatid cysts of the lungs sometimes undergo spontaneous cure, once the diagnosis has been established, if the cyst is at all accessible, there can be no doubt that bold surgical intervention offers the best chance of effecting a cure, and, in not a few cases, the only chance. But its accomplishment is by no means always either easy or simple.

On general principles the cyst should be approached from the nearest point on the surface. This point can be determined in two ways: first, by examining the patient with the fluorescent screen—the nearer the cyst to the tube the bigger will be the shadow it will cast; second, by locating the cyst with the exploring syringe. A generous resection of the rib, or ribs as the case may be, will greatly facilitate. It is almost useless to try to avoid the occurrence of pneumothorax, as with each inspiration one hears the sizzle of air entering the thorax, no matter how carefully the stitching is done. Long before the experience in the war demonstrated the fact generally, those of us who were accustomed to open the thorax for the treatment of conditions either in it or in the subdiaphragmatic region, had learned to look on pneumothorax in fairly healthy subjects as a very benign condition. It is very important, however, to use some means to fix the lung, so as to prevent the region to be treated from getting out of control by retracting deeply within the thorax. The best means I know of to accomplish this is to pass a large curved needle, armed with strong catgut, through the intercostal muscle and the still unopened pleura deep into the lung tissue. If it is not passed through the muscle it is apt to tear out. It should be passed on the side of the wound nearest the root of the lung, as when the pleura is opened the lung will retract toward the root. The pleura is now widely opened, the position of the cyst again verified with the exploring syringe, and the cyst opened. As a rule no difficulty is experienced in removing the endocyst, and as the development of the ectocyst in the lung is very slight, the cavity left has an extraordinary resemblance to normal pleura. The cut margin of the lung tissue is fixed to the margins of the wound by catgut sutures, the tension of which is regulated to control the sometimes rather free, but not very high pressured, bleeding. If the lung has not been well fixed, and the opened cyst should escape into the depths of the thorax, the search for it will, I think, provide the most enterprising surgeon with all the surgical thrill he is likely to want for that day.

Sometimes the opening of the cyst is accompanied by violent coughing, and with each cough there is a splutter from the wound of blood and hydatid contents, of which the surgeon as a rule receives his due share, and the patient sometimes becomes alarmingly cyanosed. In a very short time the lung seems to accommodate itself, the cyanosis passes off, the breathing becomes regular, but the cough may prove troublesome for some days. It then generally passes off, and oftentimes at the end of a week it has disappeared for good, to the immense relief of the patient.

The subsequent treatment consists in keeping drainage well established, in giving a good

nourishing diet, in getting the patient up early, having him take deep-breathing exercises and other moderate exercises and be in the sunshine as much as possible. This method soon effects a cure. Appended are a few short notes of some cases that have been under my care in the British Hospital.

Case 1. Hydatid of pleura, suppurating and ruptured, simulating empyema. I was called one night to see a lady who presented all the signs of an empyema. As I happened to have an aspirator with me I decided to aspirate the chest to relieve the pressure symptoms. About a litre of pus was drawn off. The next morning a rib was excised, and on opening the pleura, a hydatid cyst popped out. The pleura was drained and the patient did well for 48 hours. A urticarial rash appeared, the patient became more and more collapsed and died 12 hours later.

Case 2. Hydatid of lung, ruptured into bronchus. A man, 48 years old, complained of distress which began 7 years before, with cough and hæmoptysis followed by copious sputum and frequent and severe hæmorrhages. He had alternate attacks of fever, loss of appetite and flesh, with periods of more or less good health between when he gained in weight and was able to carry on his work as a stevedore. He is rather given to the use of alcohol. Patient was first seen 4 years ago. He is still alive and at present comparatively well. He has often spat up almost a basin full, and on several occasions bits of membrane. He recently came for treatment of another condition and is at present in the hospital. His old symptoms have almost entirely disappeared. The cough has ceased for some months, and he has gained several kilos in weight; apparently a spontaneous cure. Since the above was written this patient returned to the hospital with severe pulmonary symptoms, and subsequently died of gangrene of the lung.

Case 3. Hydatid cyst of the pleura. Girl, 14 years old, was operated on 5 years ago for hydatid of the liver. On the right side in front, absolute dullness reached from the clavicle to the sixth rib, and extended outward from the middle line to the mid-axillary line. X-ray showed a round shadow, much bigger when examined with the patient facing the tube than when she had her back to it. No breath sounds were present over the dull area. There was a patch of pneumonia in the left base, and the patient had a high temperature. As suppuration was suspected in the cyst, operation was immediately undertaken. Three and a half inches of the third rib were excised, and the lung was fixed and the pleura opened. The cyst, about the size of an orange, came away from a cavity. So thin was the ectocyst that the lining membrane seemed to be of normal pleura. Five weeks later, after a rather stormy time, an empyema developed on the other side. This was opened and drained in the usual way, and the patient left the hospital completely cured, in 4 months.

Case 4. Hydatid of the lung, rupture into bronchi and pleura simulating tuberculosis. Boy, 10 years old, was admitted with a pyopneumothorax of the left side. He presented the typical appearance of advanced tuberculosis. Thoracotomy revealed a large cyst in the base of the lung, which had ruptured both into the bronchi and the pleura. Free drainage was established and the boy completely recovered, in 3 months.

Case 5. Hydatid of the base of the lung, simulating pleural effusion. Woman, 27 years old, was ill for 3 months. She presented signs of a large pleural effusion on the left side, but had a marked bulging of the ribs and a very troublesome cough, with scanty but blood-stained sputum. X-ray showed a very dense shadow of the base of the lung. The heart was greatly displaced to the right. Extensive resection of the rib was done, the cyst was opened, free drainage established, and the patient left the hospital cured, in 3 months. Three days after the operation the cough had entirely disappeared.

ACUTE SUPPURATIVE PLEURISY

An Analysis of Ninety-Four Cases

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THIS paper is based upon an analysis of 94 cases of acute suppurative pleurisy, treated upon the Surgical Services at the Roosevelt Hospital, from January 1, 1915, to January 1, 1920, a period of 5 years. Only eleven of these were postinfluenzal, the remainder being postpneumonic. In this respect the material in this study differs from that contained in many of the recent, exhaustive, war-time reports.

The condition is usually secondary to pneumonia, either of the pneumococcic or streptococcic type: in adults, most often a lobar pneumonia; in children, frequently a bronchopneumonia. In certain cases it is impossible definitely to demonstrate a pre-existing pneumonia.

Barjon's (1) idea that empyema usually originates in an infection of mediastinal lymph nodes, with dissemination through the interlobar spaces of the pleural cavity, while an interesting theory, still lacks confirmation as a pre-eminent etiological factor.

In the bacteriological study of our series, we found the pneumococcus present in 33 of the 94 cases. Grouping was done in only 22 of these cases with the following results:

	Cases
Group I	7
Group II	2
Group III	5
Group IV	8

The streptococcus was isolated in 10 cases: staphylococcus in 5, and mixed infection in 5. Our records are incomplete as to culture in the remainder and of those in which the cultures proved sterile. In 77 of the cases the exudate was of the classical, thick, purulent variety; in 10 seropurulent; and in 7 the character was not noted.

The exudate of the pneumococcus contains more fibrin, is usually more quickly walled off, and somewhat less abundant than that of the streptococcus, which is prone to produce a thinner generalized exudate of large amount. This fact becomes of great importance in considering the dangers of open, sucking, pneumothorax following early operation for empyema of the streptococcic type.

Butler's (2) notation that in civil life the pneumococcus is found twice as frequently as the streptococcus, is borne out by our own experience. He states that these two organisms are the causative factors in 75 per cent of cases in civil practice, whereas in military life approximately 80 per cent of the postpneumonic cases were due to the streptococcus alone.

Lord (3) in an analysis of 200 cases found the pneumococcus in 30.4 per cent, streptococcus in 20.4 per cent, staphylococcus in 3.6 per cent, mixed infection in 16 per cent, and in 18.2 per cent the cultures were sterile.

Other occasional etiological factors, such as penetrating wounds, or chest-wall injuries, suppurative disease of the mediastinum or adjacent viscera, etc., do not appear in this series, with the exception of 3 cases, secondary to lung abscess. In one case of pneumococcus empyema, pulmonary tuberculosis had pre-existed for 11 months. The following are some observations brought out in the study of the series: There were 62 males, 32 females. The average age was 20.4 years. The oldest patient was 52 years. The youngest patient was 9 months. The average time from the onset of the illness to the day when the diagnosis of empyema was made was 38.2 days.

69 cases were postpneumonic.

11 cases were postinfluenzal.

3 cases were secondary to lung abscess.

In 11 cases the pre-existing cause was undetermined.

34 cases were on the right side.

52 cases were on the left side.

In 8 cases the location was not noted.

18 were in the upper half of the chest.

70 were in the lower part of the chest.

60 were localized.
17 were general.
5 were interlobar or sacculated.

No case of bilateral empyema was noted in this series.

Roentgenographic studies were made in many of the cases and were often of great value, but were not sufficient in number to present in statistical form.

In considering symptoms and signs, a delayed convalescence following pneumonia or influenza, with recrudescence or persistence of fever and signs of sepsis, should always suggest the possible development of empyema. The usual physical signs of fluid, localized or general, confirmed by roentgenography, fluoroscopy or aspiration, should soon establish a positive diagnosis.

Several cases of the localized and sacculated type presented interesting problems in diagnosis and treatment; two were high up beneath the left scapula, posteriorly; two presented multiple sacculations.

The treatment of empyema by drainage is one of the oldest operations of surgery. Many efforts have been made to simplify this procedure by substituting less radical treatment. A notable example is the formalin-glycerine injection method so strongly advocated by the late J. B. Murphy (4), which has failed to fulfill its early expectations as a substitute for drainage.

Simple aspiration, repeated, is valuable as a pre-operative procedure, to tide over critically ill cases to a period safer for radical operation; and in a small percentage of cases, especially in children, will effect a permanent cure in itself. We have had no cures in this series by aspiration *per se*, but have employed it as a preliminary to radical operation in several instances with excellent result.

The same may be said of the minor procedures of inserting small cannulæ or tubes through trocar wounds in the intercostal spaces, which we have also done a few times. These less radical procedures are especially valuable in generalized empyema of the streptococcic or postinfluenzal types, in the early stages when constitutional symptoms are severe and the margin of safety is narrow. They are also useful in severe early cases of the pneumonic type, during the period when radical operation is perilous. An illustrative case was one of pre-existing cardiac disease with marked decompensation and great dyspnœic distress, which was temporarily drained by trocar puncture and a small intercostal tube, until improvement warranted radical drainage, 8 days later, with ultimate cure. We have employed irrigations with Dakin's solution in a few such cases to prevent clogging of the small tube and facilitate drainage. This method, originated by Mozingo (5), which we have found so useful as a temporary procedure, we have not succeeded in carrying through to a complete cure of the condition, but have not, perhaps, persisted long enough in the effort to give it a thorough trial. Neither have we used Dakin's irrigations through the small tubes, with the idea of effecting complete sterilization of the cavity in acute cases; though we have used it for this purpose in three instances, in later stages after thoracotomy and drainage.

Some newer methods worthy of mention, with which we have had no personal experience, are the "tidal irrigation" of Taylor (6) of Toronto; the negative pressure closed method of Brix (7); the oblique intercostal incision with valve-flap action, etc.

Open intercostal tube drainage without rib resection, was employed in 15 cases, with 5 deaths; this group representing critically ill cases unsuitable for more radical operation. Local anæsthesia was used in 14 of these cases.

Instead of using an incision parallel to the ribs, Morison (9) has suggested a vertical incision down to the ribs and across the intercostal space, with the idea of preventing kinking of the tube by respiratory movement and change of position.

Rib resection was employed in 79 of our series, in the majority of cases using the eighth rib in the posterior axillary line.

In the earlier cases of the series the Brewer spool with siphon bottles or the Connell suction apparatus was the method of choice. Later, on the Second Surgical Division, the following procedure has been adopted as a routine: A large firm rubber tube, three-fourths inch in diameter and about 6 to 8 inches

long, projecting 1 to 2 inches into the pleural cavity, is anchored in position by suture. Gauze plugs on either side and careful suture of the wound angles tend to prevent sucking of air around the tube. The end of the tube is immediately clamped; a small split compress around the tube is at once strapped tightly to the chest wall with adhesive plaster carefully fitted, to complete the air-tight joint. A flange of rubber dam through which the tube passes may be used beneath the strapping to effect a more perfect closure. Gauze pads held by a binder, complete the dressing. On return to the ward a long tube of smaller caliber, with its end submerged in solution in a large bottle on the floor at the side of the bed is attached to the large drainage tube by a tapered glass connection. Each inspiration tends to draw a column of fluid up in the tube producing a degree of negative pressure in the pleural cavity. Assuming that an air-tight joint has been secured, no air can enter the chest through or around the tube. Pus from the cavity flows into the bottle and settles at the bottom. Change of the fluid once or twice a day is sufficient, the tube being clamped each time. The amount of pus diminishes rapidly from day to day, and as a rule there is little or no soiling of the gauze dressing on the chest wall. We have repeatedly found it unnecessary to change it for a full week. Offensive pus-soaked dressings are practically eliminated by this method. If the attempt to secure an air-tight joint has failed, complete change of the dressing down to the chest wall and readjustment of the strapping will usually overcome the difficulty.

After the fourth or fifth day the patient is put on Wolff blow bottles, and encouraged to use deep breathing to expand the lung. At from 7 to 10 days the air-tight drainage has usually accomplished its purpose, the pleural adhesion to the chest wall has progressed to a point eliminating danger of lung collapse. The original tube is removed and replaced by one smaller, but still of good size; e.g., one-half inch diameter, which is cut short and covered by fluff gauze. Within the next week the cavity has as a rule become a simple tube tract. Tubes progressively shorter and of smaller caliber are used until the tract is simply a thoracic wall sinus.

Throughout the treatment care must be taken to prevent unrecognized plugging of the tube or the formation of lateral pockets. In the later convalescence, balcony treatment, deep breathing and chest and arm exercises are insisted upon.

We have not employed the method of open drainage with Dakin irrigation of the cavity, so widely used during the war, sufficiently to express an opinion as to its value, but feel that the method described has given quite as satisfactory results, both as to percentage of recoveries and time of convalescence.

We have used local novocaine analgesia in 54 cases and consider this the method of choice, especially in critically ill cases. General anæsthesia, open drop ether was employed 35 times, sometimes combined with local, to minimize the amount required. In children general anæsthesia is usually necessary.

We cannot claim a mortality to compare with the 4.3 per cent of the Empyema Commission (8), but have not attempted to exclude deaths really due to the pre-existent pneumonia.

Eighteen of the 94 cases died in the hospital, a mortality of 19.1 per cent. Three deaths attributed to operative shock may well have been due to the existing pneumonia. Two died of pneumonia of the opposite lung. Two of cerebral embolism. In 9 death was attributed to sepsis and exhaustion, pneumonia probably being an important factor in some of this group. In 2 cases the cause of death was not stated.

Hæmorrhage from intercostal vessels did not occur in this series, but in a recent case, an elderly debilitated patient, death occurred from this cause, 9 days after operation, after removal of the drainage tube.

Of the remaining 76 cases, late results are known in 60 (76.3 per cent). Forty-nine cases healed completely, and have remained closed, the average time being 9.1 weeks.

In 11 cases secondary abscess required opening. One of these has been operated upon three times and still has a discharging sinus. Two of the secondary operations were done elsewhere.

Another case operated upon July 1, 1917, developed a secondary abscess in February, 1921, and still has an unhealed sinus. Another case broke open 14 months after primary closure, final healing being complete in 8 months. Eight cases reported secondary operations, three of which healed within 1 year, 5 within 2 months after the secondary operation.

SUMMARY

Total cases treated.....94
Mortality (18 cases).....19.1 per cent
Closed and remained closed.49 cases of the 60
(average time 9.1 weeks) (80.1 per cent)
(late reports)
Persistent sinuses and secondary operations.....11 cases

No attempt has been made in this paper to deal with the special problems arising in the management of chronic, late, or neglected cases of empyema as these form a distinct group in themselves.

CONCLUSIONS

1. The successful treatment of acute empyema is still based upon measures which provide adequate drainage.

2. The principle of air-tight drainage, avoiding an open, sucking pneumothorax, with moderate negative pressure to keep the cavity constantly empty, is of primary importance, and favors the rapid diminution of the size of the cavity until it becomes a simple tube tract. It is one of the greatest recent improvements in the management of these cases.

3. Palliative pre-operative measures, e.g., repeated tapping, are important in the early stage of severe cases, especially those of the postinfluenzal or streptococcic types, or when pneumonia is not completely resolved, radical operation being postponed pending improvement in the general condition.

4. Closed tube drainage by the method described compares favorably in results as to recovery and time of healing, with the method of immediately dakinizing the cavity for the purpose of sterilizing it. Early bacteriological examination is of aid in determining the prognosis and plan of operative procedure.

5. The use of roentgenography and fluoroscopy is of great value in determining the position and extent of the exudate.

6. Local analgesia is the method of choice except in children where open drop ether may be necessary.

7. Improvement in constitutional symptoms following operation for postpneumonic cases in our series was usually prompt; while in postinfluenzal cases 4 or 5 days elapsed before similar improvement was attained.

8. Balcony treatment, blow bottles, deep breathing, and chest and arm exercises should be instituted early in the convalescence.

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HYPOPHYSEAL DUCT TUMOR IN A CHILD OF TEN[1]

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TUMORS of the hypophyseal duct are still of sufficient rarity to warrant their being reported. The following case occurred on the Surgical Service of the Children's Hospital in Boston. The relative infrequency of these squamous-cell tumors is seen by the fact that in Cushing's work, reported in 1912 (2), only two authentic cases are recorded. It adds one case to the thirty-eight originally reported by Jackson (7, 8) in 1916, the seventeen additional ones reported by Duffy (3) in 1920, and the three reported by Bailey (1) in 1921.

Marjorie W., aged 10 years, 7 months. Children's Hospital No. A-39591. Admitted July 5, 1921.

The father and mother are living and well. There is one other younger sister who is living and well. There is no history of miscarriage or of tuberculosis.

The child was a full term baby and was normally delivered. She had a normal feeding history. At about 5 years she had measles, and a short time later this was followed by pertussis. Aside from these two contagious diseases, there is no past history of any illness or trauma to suspect as an etiological factor in the present illness.

Present illness. About 7 months ago the child began to have occasional attacks of vomiting accompanied by a moderate fever and pronounced constipation. These attacks increased in frequency since that time. The child was admitted to the hospital with a diagnosis of subacute appendicitis following one of these attacks of fever, constipation, and vomiting 10 days ago. There has been very little abdominal pain except on defæcation.

Physical examination. The head is of normal contour. The pupils are equal and react to light and distance. The extra-ocular movements are normal. The corneæ, sclera, and conjunctivæ are clear. The nose and throat are negative. The chest is symmetrical, well developed, expansion equal. The lungs are clear throughout. There is no dulness; no râles or changes in breath sounds are heard. The heart is not enlarged, its action is regular and of good quality. The abdomen is slightly tender all over. The entire colon is readily palpable, and is filled with fæcal masses. No true spasm is obtained. There is no localized tenderness.

Operation, July 6, 1921. Simple appendectomy under ether anæsthesia. Recovery was normal and uneventful and without rise of pulse or temperature. Examination of the appendix showed some slight thickening of the wall microscopically.

July 8, 1921. Two days following operation the child vomited. Vomiting was not definitely projectile. The child appeared drowsy as if tired out, and was aroused with some difficulty. Physical examination essentially negative, as noted before.

July 8, 1921. The child made a normal recovery following operation, but still showed the same symptoms of occasional attacks of nausea and vomiting accompanied by moderate fever and constipation. In view of this circumstance more complete data concerning the earlier history were obtained. It was found that she had had trouble with her eyes for slightly over 2 years. In school she had difficulty with her vision and was seen by an ophthalmologist who fitted her with glasses. Following this there was temporary improvement. The family physician thought at that time that these visual disturbances might be associated with kidney lesions, but none were ever definitely found. During the summer of 1919 the child was under the care of a children's specialist who considered this visual defect one of nervous origin which she would probably outgrow. She was examined carefully at the Eye and Ear Infirmary in the fall of 1919, and only mild refractive errors were noted. Again in November, 1920, she was re-examined at the Eye and Ear Infirmary and similar refractive errors found. Nothing abnormal was noted at these examinations about her fundi. In December, 1920, she began having abdominal pain, as noted in the earlier history, accompanied by headache, rise in temperature, and vomiting of a semiprojectile character five or six times at 10 or 15 minute intervals. The vomiting was usually relieved by enemeta. Following one of these attacks she would be drowsy for several days. She was bothered considerably by an obstinate constipation which did not yield to the usual drug treatments. At that time she was put on a strict diet and given careful directions concerning personal hygiene. She had no trouble for 3 months, and then in March, 1921, had a similar attack. At that time X-ray of the gastro-intestinal tract showed a long kinked appendix, and since that time these attacks have been attributed to that recognizable pathological lesion.

(Dr. Bronson Crothers.) *Neurological consultation.* The examination proved to be negative except for the eyes. The pupils were found to be slightly dilated, of equal size, and they reacted to light and

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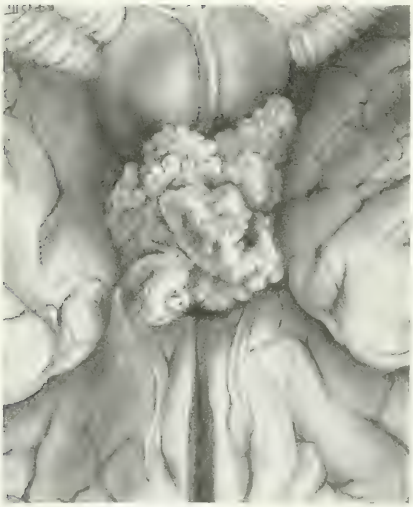

Fig. 1. Hypophyseal duct tumor from below. Note compression of optic chiasm and invasion of third ventricle. The polycystic nature of the tumor is evident from the verrucous-appearing surface. Blood supply from the vertebral vessels.

distance. The fundi both showed some slight blurring of the edges of the discs, but there was no true choking. The blurring was not sufficient to be inconsistent with marked refractive errors. Question of a cerebral lesion, possibly a tumor, was raised at this time, but on the basis of the physical examination could not be definitely proven. She was seen again in consultation, and nothing additional or definite was found in the fundi to establish a diagnosis of cerebral tumor. X-ray examination (Dr. Percy Brown) of the sinuses was negative.

Ophthalmological consultation. July 23, 1921. There is a swelling of both discs of about 5 diopters, with tortuous vessels. There are no hæmorrhages. The macular region is normal. There is slight divergence of the left eye which is due to pressure. The visual fields are difficult to obtain and suggest a bitemporal hemianopsia. X-ray examination of the sella is said to be normal, but the posterior wall looks somewhat indefinite. Lumbar puncture shows increased pressure, but is otherwise negative.

July 25, 1921. X-ray examination of the head. Ventriculograms with air injection under an anæsthesia show greatly dilated ventricles laterally. The third ventricle is not outlined. Cerebellar decompression advised.

July 27, 1921. Cerebellar decompression under ether anæsthesia. The patient is put on her face and a cross-bow incision made over the cerebellar region. The decompression is made sufficiently wide to expose the foramen magnum. The cerebellum is found to be tense. The ventricles are tapped and found to be under greatly increased pressure. The dura mater is opened and the cerebellum explored. No tumor is found. There is no block in the aqueduct of sylvius, as fluid injected into the lateral ventricle comes out through the aqueduct. There is no evidence of a cyst. The dura is closed and the skin sutured. The child is in poor condition at the end of the operation. About an hour after operation the child went into shock with complete collapse and died. Postmortem examination obtained within 4 hours of death.

Autopsy. Marjorie W., 10 years, 7 months. 4 hours post mortem. (Autopsy restricted to head.)

Diagnosis. Cystic hypophyseal duct adamantinoma of squamous epithelial cell rest origin.

Head. The head is of normal contour. It is completely shaven and presents two surgical incisions, one over the right temporal bone which has healed by first intention, and a second over the occiput in the form of a large T. This incision has been extended laterally in order to reflect the scalp over the calvarium. Under this posterior T-incision is an area of decompression which exposes the meninges over the cerebellum. Over the right temporal area, there is a small decompression trephine which appears clean. The calvarium is removed by connecting these decompression trephine openings. The dura is markedly injected, but shows no evidence of any infection. It contains over the occipital area sutures which show no evidence of secondary infection. The dura is removed by parallel incisions along the falx cerebri which is cut through anteriorly and the falx removed. The longitudinal sinus appears normal. The tentorium is incised along the temporal bone. The anterior lobes of the brain are lifted and expose a tumor mass lying between the olfactory nerves and obliterating from view the optic chiasm. (Fig. 1.)

This growth is covered by normal appearing pia-arachnoid. It is about the size of a large walnut, rather lobulated in appearance, with numerous verrucous-like projections on its surface. It is grayish white in color and appears to be definitely associated with the pituitary body. The brain, with the pituitary, is removed *in toto*. No lesions of the brain itself are noted in the gross. The tumor mass occupies the space between the optic chiasm and the infundibular stalk, to which it appears attached. In removing the hypophysis it is noted that the sella has undergone definite atrophy and destruction of its posterior wall. The tumor is cystic in appearance and somewhat fluctuant on palpation. One lobe of the tumor occupies definitely a portion of the sella and seems to arise from the anterior portion of the gland. The posterior portion of the pituitary appears normal. The tumor has grown down into the space normally occupied by the third ventricle, has partially occluded the foramina of Munro, and caused

slight internal hydrocephalus. There is no actual attachment, however, at any point to the cerebral tissue, and whatever pathology is present is due to direct mechanical pressure. The tumor is removed by dissecting away the arachnoid. It is cut in half, one-half being preserved in formalin, the other sectioned and fixed in Zenker's fluid. The appearance in the gross suggests a pituitary tumor arising from the anterior lobe except for its cystic appearance. It measures 5 by 4 by 4 centimeters before sectioning. There is one large cyst which occupies about a third of the tumor mass in the deeper portion of the tumor found in the third ventricle. The cut surface of the tumor presents a somewhat adenomatous appearance, with grayish white stroma, in which are yellowish gray masses of tissue, almost suggesting adenomata. No absolute etiology of the tumor can be made out from its study in the gross, but it most strongly suggests an anterior lobe origin.

Microscopical examination. Microscopically the tumor presents the same general structure throughout. It is essentially an epithelial tumor with an adenomatous-appearing arrangement of its cells, presenting numerous nodules with a markedly arborescent tendency. They grow in trabeculæ, which in turn spread out and form many branching lobules.

These masses of cells as shown in Figures 2, 3, and 4 are of a rather high cylindrical type. They present a basement membrane externally, and centrally contain a loose stroma of cells which have interlacing fibrils. In many places these cells tend to become concentrically arranged, forming pseudo-epithelial pearls, and thus establishing their epithelial origin. No actual keratinization is noted. Many of these pseudo-pearls have accumulated lime salts and are undergoing definite calcification. In places the tumor grows in solid cords which tend to spread apart and become cystic centrally, with a single layer of columnar epithelium lining them. Such a picture is presented by the wall of the large cyst which was noted in the gross. This epithelium varies from high columnar to a relatively low cuboidal, and presents in many places a pseudo-stratification. The cells making up the stroma of these adenomatous evaginations are in places difficult to distinguish from fibrous-tissue cells except by differential stains. The nuclei tend to become oval and the intercellular substance resembles closely the collagen and fibroglia fibers of connective tissue. One section of the tumor shows an interesting arrangement of the tumor cells, forming one of the cysts previously noted. It is filled with a homogeneous pink-staining material, which appears

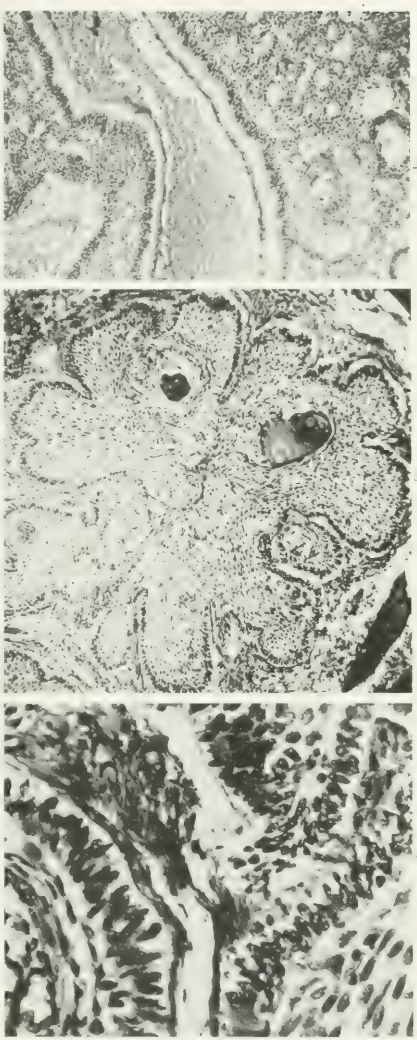

Fig. 2. Photomicrograph, low power, showing a true adamantinoma arising from the jaw. Note the reversal of the nuclear arrangement of the basal layer, with the cytoplasm toward the cystic portion of the tumor.

Fig. 3. Low power photomicrograph of the tumor. Note the arrangement of the cells of the basal layer, the nuclei arranged toward the cystic central portion of the tumor. Also note the squamous cells tending to cornify and undergo calcification.

Fig. 4. High power photomicrograph of the same. The epithelial character of the cells is apparent.

to be mucinous in character. At the periphery of this cyst are numerous groups of cells, apparently budding from this single layer of lining epithelium. These buds in turn extend into the stroma of the tumor, forming other smaller cystic areas or similar arborescent nodules previously described. The stroma of the tumor is composed of a delicate fibrous-tissue reticulum in which some focal areas of hæmorrhage have occurred, with necrosis of the tissue. There is nowhere in the actual tumor any evidence of pituitary body cells. At the periphery of the tumor in certain of the sections there are normal appearing anterior lobe cells. These are separated from the tumor by a dense connective-tissue layer which seems definitely to preclude any association of the origin of the tumor from either lobe of the pituitary. The character of the epithelium of this tumor, with its adamantinomatous appearance, suggests strongly the origin of the tumor from hypophyseal duct rests.

EMBRYOLOGY AND ETIOLOGY

Duffy (3), in his admirable article upon hypophyseal duct tumors, has discussed the embryology in great detail, reporting the earlier work of Erdheim (4, 5) and other anatomists. Briefly, the hypophyseal duct and the hypophyseal vesicle or Rathke's cleft, develop independently of one another. The latter is a normal finding in early adult life and consists of a slit-like fissure lined by a single layer of cylindrical epithelium. From this cleft arise the simple cysts of the hypophysis. The hypophyseal duct, on the other hand, consists of a modified squamous epithelium which gradually becomes cubical and merges with the epithelium of the buccal cavity. This duct retrogresses, and by adult life should be completely obliterated. Erdheim, however, has demonstrated persistent fœtal inclusions in the region of the hypophysis, which usually occur at the "insertion of the erstwhile hypophyseal duct which is carried upward by the further rotation of the developing gland to the anterior infundibula and the upper pars anterior surfaces." Again, the so-called pharyngeal or accessory hypophyses, which are so conspicuous in certain of the lower vertebrates, may persist in man, and again give rise, as fœtal inclusions, to tumors in later life. "It seems evident that the entire region of the hypophysis, from the pharynx to the processus lingualis of the pars intermedia, is peculiarly rich in vestigial reliquiæ which may be considered as possessing both function and tumor-producing possibilities." (Duffy.)

CLASSIFICATION

Duffy has followed the usual classification of tumors of this region into three chief groups, all falling under the general heading of heterogeneous hypophyseal tumors, in other words tumors arising from cells playing no part in the actual glandular tissue. They are subdivided into (a) simple epithelial cysts, usually of a papillary character; (b) the somewhat complex adamantinomatous-appearing tumors, the so-called "autochthonous teratoids developing by metaplasia from hypophyseal duct remnants" (Ewing, 6), and it is in this larger group of cases that the report is included; (c) the group including the true teratomata with cells of all three germ layers, and likewise the rare malignant cases which, as reported by Duffy, number only five.

The case reported here is quite comparable to Duffy's Case 2, a summary of which is presented.

> A girl of 11, with a history of headaches for 5 years, and excrescence of sex features since the age of 9. There has been progressive failure of vision for 1 year and projectile vomiting for 8 months. A cystic suprasellar tumor was evacuated at operation. Microscopic examination showed a characteristic adamantinomatous tumor developing from an infundibular squamous epithelial rest of the hypophysis. The child died and no autopsy was obtained.

Again Case 2, reported by Bailey, is somewhat comparable to the present one, occurring in a young boy of 11, a cyst evacuated by operation, and secondary meningitis followed by death. An autopsy was obtained, and a typical cystic epithelial adamantinoma found.

The nomenclature seems to have become generally accepted following a period of over 20 years, in which many confusing terms are found in the literature. Among these may be mentioned the ependymal papilloma, the papilloma of the choroid plexus, cystic pial endothelioma, and the craniopharyngeal duct tumor. This latter term is practically synonymous with the hypophyseal duct tumor which is most frequently applied at the present time to these tumors.

DIAGNOSIS AND PROGNOSIS

Duffy in particular feels that X-ray examination of the head is of great value in establishing a definite diagnosis, as these tumors are usually found just behind the optic chiasm, usually above the sella, although they frequently invade it. The presence of calcified nodules in a suprasellar position is almost in itself diagnostic. The chief difficulty is in differentiating these tumors from true teratomata or dermoids before operation. The latter, however, are much less common and offer an equally poor prognosis. Only one case thus far is on record of recovery following operation.

SUMMARY

A case of hypophyseal duct tumor in a child of 10, showing symptoms for slightly over 1 year, is presented. A discussion of the embryology and etiology is given, emphasizing the importance of the vestigial reliquiæ of the embryological hypophyseal duct.

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LYMPHATICOSTOMY IN PERITONITIS

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In November, 1922, I published the results of experimental research which go to show that there is a fatal absorption through the thoracic duct in diffuse septic peritonitis (1).

The problem was attacked from a purely surgical point of view, it being assumed that before a study of absorption could be conducted a true diffuse septic peritonitis would have to be set up in the animal and the peritonitis would have to be uniformly fatal. Such a fatal peritonitis was found in the dog by ligating the appendix and mesoappendix thereby occluding the blood supply. When this was done the dog invariably died with a diffuse septic peritonitis in about 2 days, having run a uniform course of the disease. It was found impossible to set up a uniform peritonitis which would be of value for this experimentation by injecting bacteria into the peritoneal cavity. Human germs taken from an appendiceal abscess and dog germs taken from a dog with diffuse septic peritonitis were equally ineffectual in setting up a peritonitis when injected into the peritoneal cavity. The presence of the necrotic appendix was necessary in commencing the pathological process.

In the second stage of the experimentation the thoracic duct was ligated in the neck 24 hours after the appendix had been ligated and the abdomen closed. The first dog developed a thoracic duct fistula and promptly recovered. Four dogs recovered in a similar manner. In the third stage the duct was not only ligated but opened below the ligature so as to assure a drainage of lymph from the system. Three dogs recovered in this series.

It was shown that the damage done to the thoracic duct by the operation was overcome by the establishment of a collateral flow of lymph.

The experimentation demonstrated what it was intended to show, that there is a fatal

Fig. 1. First step.

Fig. 3. Third step.

absorption through the thoracic duct. It not only proved the fact but it disproved a fatal absorption through the subperitoneal capillaries or through the diaphragmatic lymphatics to the anterior mediastinal lymphatics and the right lymphatic duct. It showed, moreover, what is perhaps the most extraordinary fact of all, that when a fatal absorption is overcome the peritoneal cavity is capable of looking after such a formidable structure as a necrotic appendix.

The experimentation was carried out between May, 1921, and the middle of 1922, and on October 10, 1922, I had an opportunity of applying the findings in a case of pneumococcic peritonitis in a girl of 9 years at the Sick Children's Hospital in Toronto.

Fig. 2. Second step.

Miss G. B., age 9, admitted October 10. Patient was crying out with abdominal pain; she was toxic, the tongue was dry and coated; the abdomen markedly distended, rigid and uniformly tender to the lightest touch; dullness was present in flanks; temperature, 101°; pulse, 140; white blood cells, 13,000. Diagnosis: pneumococcic peritonitis.

Operation. Lymphaticostomy, midnight, October 10, 1922.

Under intratracheal ether a 3-inch incision was made along the lower posterior border of the left sternomastoid muscle. That muscle was freed by blunt dissection and drawn in exposing the omohyoid muscle which was drawn up. The internal jugular vein which was thus exposed was liberated down to the junction with the subclavian vein, rolled inward, and the thoracic duct about the size of a goose-quill brought into view. It was freed for about 1 inch and a ligature of plain catgut tied about it close to its entry into the vein. A half-inch longitudinal incision was made into the lumen of the duct a little distance below the ligature allowing the lymph to flow. Swabs were taken of this fluid for examination. A narrow strand of rubber was passed about half an inch down the duct. A single strand of half-inch, plain selvedged gauze was loosely tucked around the duct. The rubber strand, the gauze and one end of the ligature were brought to the surface and secured to the skin. The skin incision was then closed with a short quarter-inch soft rubber tube and a moist dressing was applied.

Blunt dissection made almost a bloodless operation so that it was not found necessary to ligate a vessel. Half a cubic centimeter of pus was aspirated from the right side of the peritoneal cavity for examination. The patient was exsanguinated and transfused, 600 cubic centimeters being drawn off and 800 cubic centimeters introduced. Patient made good recovery from operation.

Bacteriological findings: Culture from duct nega-

tive for pneumococcus; pus from peritoneal cavity contained pneumococcus IV; blood culture negative.

Unfortunately the duct fluid was not tested for toxicity. Rapid disappearance of all toxic symptoms, however, proved that absorption had ended.

Progress notes: October 11: Marked improvement. Abdomen softer and less painful. Tongue clean. Patient bright and asking for milk. Neck wound draining freely. Culture again negative for pneumococcus. Temperature, 101°; pulse, 120.

October 12: Condition excellent. Voluntary bowel movement. Lymph draining freely. Gauze removed. Given broth and lemon albumin. Temperature, 101°; pulse, 110.

October 13: Slight drainage from neck. Temperature, normal. Fluid diet.

October 16: Rubber tube removed. Sitting up in bed. Soft diet.

October 17: Strand of rubber removed. Practically no drainage from neck.

October 18: Stitches removed. Wound healing rapidly.

October 19: Slight evening rise of temperature. Some hardness in right iliac fossa which is not painful on pressure. No other symptoms.

October 23: The area of hardness extends up from Poupart's ligament about 3 inches, is a little painful on pressure; it has no definite boundary, is tympanitic and appears to be in the anterior abdominal wall. Patient looks well and is taking soft diet. Bowels move voluntarily. Temperature rises to 100° in the evening. White blood cells, 12,000.

October 24: The hardness in right side has disappeared. Temperature down.

October 30: Patient discharged cured.

The operation in peritonitis is not only unique but it is full of interest and opens up a wide field for discussion. What happens to the duct? In the surgery of the neck the ligation of the duct, when it has been opened by stab wounds or otherwise, is effectual in promoting recovery and in such cases a collateral flow of lymph occurs. The experimental work referred to and that reported by Frederick Lee (2) prove that a collateral flow is readily set up and that a ligation or an opening in the duct heals readily. Wilms (3) drained the duct for fat embolism in a man of 20 who fell from a second-story window. He divided the duct which drained freely for 36 hours. In the first 20 hours 2 quarts escaped. The vessel closed in 6 days and patient recovered. Murphy (4) quotes the statement by Jonnesco that systematic ligation of the duct has been resorted to several times in the human in some abdominal cancers. While the duct is draining there is a loss of the food constituents of the lymph and while this would entail a loss of weight in a normal individual when drainage is carried out, in a case of peritonitis this factor is negligible, for in such a condition there is little or no absorption of food until the abdominal symptoms have subsided and by that time the duct drainage has lessened and a collateral flow of lymph is being set up.

What happens to the pus remaining in the peritoneal cavity? In the dogs operated upon the pus disappeared without abdominal drainage and without apparent pocketing. In what way this was effected is a matter of conjecture. In the case reported it was thought for a few days that a localization of pus was occurring in the right iliac fossa, but this cleared up rapidly and no pocketing occurred. In the dogs, not only the pus but the necrotic appendix was disposed of, without operative interference.

It is not wise to judge the efficacy of lymphaticostomy on the result of this one case as it might be said that the patient may have recovered with peritoneal drainage, notwithstanding a mortality of about 90 per cent in children, and further recoveries must be reported before this procedure can be adopted by the profession to whom this case is presented in the light of a good hope for the future treatment of diffuse septic peritonitis.

To those who are accustomed to witness the postoperative course in abdominal drainage in peritonitis this case exhibited a happy contrast, for the postoperative treatment was attended by almost an absence of suffering.

This case demonstrated the following observations which featured in the experiments:

1. The elimination of toxic or bacterial absorption from the peritoneal cavity and the lumen of the bowel cuts short those symptoms which are commonly observed in postoperative peritonitis.

2. The wonderful ability of the peritoneal cavity to deal with an inflammatory process when not hampered by absorption.

3. Lymphaticostomy in itself is not a dangerous procedure.

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OBSTRUCTION AT THE URETEROVESICAL VALVE

By THOMAS N. HEPBURN, M.D., F.A.C.S., Hartford, Connecticut

IT has been often observed that obstruction of a spastic nature at the bladder outlet may cause retention of the urine with marked distention of the bladder. I wish now to call attention to obstruction of the ureter due to a spastic condition of either the circulatory muscle fibers of the ureteral mouth or of the bladder muscle fibers surrounding the ureter in the intramural portion, causing distention of the ureter and kidney.

Every cystoscopist has noted that at times the ureteral os can contract to a pale dimpled knob, in which it is impossible to engage a catheter. Again he has noted that his catheter may be easily admitted into the ureter only to be clamped in the intramural portion by a spasm of the bladder. At times one ureter may be catheterized before the bladder goes into a spasm, which makes catheterization of the second ureter impossible, and we attempt to do a differential function with a catheter in the bladder to get the functional output from the non-catheterized side. To our surprise we find there is no output of any urine from this side. If pain develops in the non-catheterized side, similar to that for which the patient seeks relief, we may be tempted to make a diagnosis of serious renal pathology requiring nephrectomy. The true situation may be that the kidney is not at all diseased, but is functioning into a ureter that is closed temporarily by a spasm at its outlet. This spasm produces distention of the ureter and renal pelvis and this reproduces the original pain.

Not infrequently a patient gives a history of typical ureteral colic, first on one side and then on the other, or on both sides at the same time. The X-ray is negative for stone. In a quiescent period, bilateral catheterization may be accomplished and normal urine and normal function found from both kidneys. A diagnosis of small stone may be made, which the patient is sent home to pass. He gets well or has subsequent attacks. In the first instance we congratulate ourselves on our diagnostic acumen. If the second occurs, we examine him again with the same findings, and perhaps call him a small stone maker.

Occasionally we find a patient with a stone in one side and his pain in the other. Such a case may be reported as another example of "reno-renal reflex" or "crossed" sympathetic pain, while, as a matter of fact, the stone may not be causing obstruction to the urinary flow

Fig. 1.—Case 1. Roentgenogram showing large ureter.

Fig. 2.—Photograph of ureter removed in Case 1.

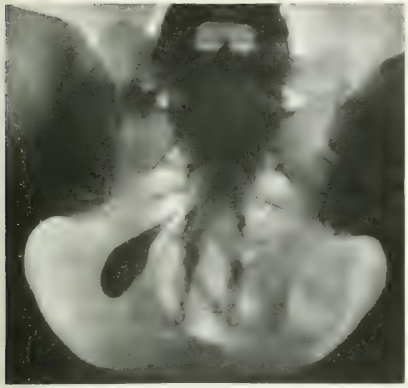

Fig. 3. Case 2. Roentgenogram showing remarkable shadow in left pelvis.

on its side, but may set up a spasm of the bladder that does obstruct the emptying of the opposite ureter, causing renal distention and colic.

Before the days of pyelographs and shadowgraph catheters, every surgeon has had the embarrassing experience of operating for shadows in the region of the lower end of the ureter and a typical history of renal colic, without finding a stone. In his effort to locate it he has opened the bladder and passed instruments up the ureter. The patient has gotten entirely well, but no satisfactory explanation has been given.

In support of my conviction that spastic obstruction at the ureteral outlet is a common and serious urological condition, I wish to present the following cases.

Case 1. Mr. O'Meara, age 19, discharged from the Navy with complete disability from chronic pyelitis and cystitis. He had been in various Navy hospitals and had had various men attempt to catheterize his ureters without success. After many months of failure he was sent home completely disabled. He entered the Hartford Hospital and was referred to me. At cystoscopy I failed to catheterize either ureter because of spasm. In order to make a diagnosis I opened his bladder suprapubically, dilated the ureteral openings with sounds, and then catheterized both sides. I found the right kidney urine normal and the right kidney function as determined by phthalein to be normal. The left kidney urine

Fig. 4. Case 3. Roentgenogram showing multiple bilateral renal stone, dilated ureters, kidney pelvis and calices.

was full of pus and its function slight. A thorium X-ray picture of the left side showed marked hydronephrosis. The boy was in bad shape, so I did a quick left nephrectomy, taking about 2 inches of the ureter. The boy convalesced slowly and went home without fever. He continued to have recurrent attacks of pain in the left ureteral region and recurrent pyuria. I again catheterized the left ureter and injected thorium. The X-ray picture is shown in Figure 1. The catheter has slipped out of the ureter, but the large ureter is easily seen. I then removed the ureter clear down to the bladder. It is shown in Figure 2. Note the small opening into which a tooth pick is inserted with a very snug fit. Since then the patient has been entirely well.

Case 2. Mrs. Brown, age 26, was seen by me at the Manchester General Hospital. She had been running a septic fever for weeks. Her X-ray (Fig. 3) revealed a remarkable shadow in the left side of the pelvis. Cystoscopy revealed a ribbon of pus coming from the left ureter, which could not be catheterized, and the right kidney was functioning normally. A mass could be felt in the left pelvis by vaginal examination. My diagnosis was pelvic ectopic pus kidney with stone. At operation I found an enor-

Fig. 5. Case 4. Roentgenogram showing remarkable looping of catheter in right ureter.

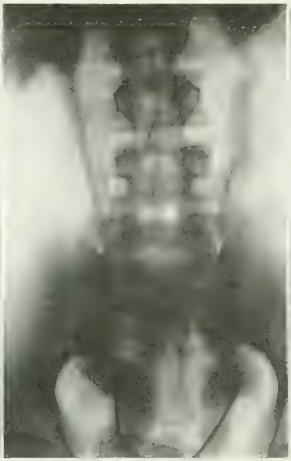

Fig. 6. Case 4. Roentgenogram showing distention of both ureters and renal pelves.

Fig. 7. Case 4. Roentgenogram taken with No. 26 F. rectal tubes up each ureter.

mously dilated ureter flopping down behind the bladder, with the point of the stone directed to the entrance of the ureter into the bladder wall. I resected the ureter at the bladder wall and dissected it up over the big iliac vessels with much difficulty and sutured it to the skin of the loin for nephrectomy at a later date, because the patient's condition did not appear to justify a continuation of the dissection at that time. I could not get any pictures of this ureter, but it was as big as an ordinary intestine, and the primary lesion appeared to be a spastic obstruction at the bladder. This woman's bladder was trabeculated. No Wassermann has yet been taken. Her pus kidney seemed to discharge itself through the ureter as she is now in good general health and very wisely refuses to let me complete my operation.

Case 3. Mrs. Cooper, age 35, entered the Hartford Hospital with right-sided renal pain, fever, pyuria. Her condition was bad. She had had back pain for years and had been getting progressively weaker. Bilateral ureteral catheterization showed pus from the right kidney and only a trace of phthalein from either in 1 hour after an intravenous injection. X-ray showed multiple bilateral renal stones and thorium injections showed dilated ureters and kidney pelvis and calices (Fig. 4). This distention appeared secondary to a spasm at the ureteral outlet, as she had a markedly trabeculated bladder. She died without surgical interference in 8 days. (Wassermann was negative.) Autopsy showed no obstruction to the ureters except at the intramural portion.

Case 4. Mr. Olson, age 37, was referred to my service at the Hartford Hospital by Dr. Hutchison. He had been treated for some time for chronic nephritis, having had several periods of œdema due to renal insufficiency. He had had no bladder symptoms. His renal function with the phthalein was only a trace. Finally he got a little fever and his urine showed a few pus cells, and he was referred for cystoscopy.

His bladder wall was perfectly normal, as were also his ureteral openings. My associate, Dr. Spillane, succeeded in catheterizing both ureters and found no leucocytes and only 15 per cent phthalein from right kidney and a trace from the left, with leucocytes. X-ray with the catheters showed the remarkable looping of the catheter in the right ureter (Fig. 5). Then for the first time we suspected a dilated ureter and injected thorium, showing the distention of both ureters and renal pelves, as seen in Figure 6.

Feeling that this man's nephritis was due to chronic back pressure from the spastic ureteral outlets, I decided to relieve this obstruction by operative procedure. Through a suprapubic incision I opened the bladder, dilated the ureteral openings with sounds, cut the ureter open from its os well up into the bladder wall, inserted a No. 26 F. rectal tube into each ureter and sutured them to the abdominal wall so that they could not slip out. The X-ray of this man with the No. 26 F. rectal tubes up each ureter is in Figure 7.

These tubes were left in for 10 days – the kidneys

Fig. 8. Case 4. Roentgenogram taken after wound had healed showing renal pelves and ureters all a portion of the bladder.

Fig. 9. Roentgenogram, Case 4, just after patient had voluntarily voided. Kidney pelves and upper ureter are empty.

being irrigated daily. His renal function rapidly improved. After 3 weeks' time, when the wound had healed, his bladder was filled with thorium to see if the ureterovesical valves were still destroyed. The picture is shown in Figure 8. It shows the ureters and renal pelves to be now all a portion of the bladder. The question was whether we may not have substituted the vesical sphincter for the spastic ureteral outlet as a cause of chronic back pressure on the kidneys. The next picture (Fig. 9) is taken just after the patient has voluntarily voided. It shows that the kidney pelves and upper ureters are empty. Therefore, if this man empties his bladder at reasonable intervals, his renal parenchyma will only be pressed upon for short periods. He was sent home with this advice and in 6 weeks has gained 20 pounds and a return of phthalein output to over 30 per cent.

Case 5. Mr. Kane, age 23, entered the Hartford Hospital on the service of my associate, Dr. Spillane, with acute right-sided renal colic and a history of having passed no water for 12 hours. There was no urine in his bladder. At cystoscopy we could not catheterize his right ureter because of spasm. He had a marked hypertrophy of the interureteric ridge. X-ray revealed a completely calcified tuberculosis of the left kidney. Rest, hot packs, and morphine finally relieved the spasm obstructing the right ureter and revealed a perfectly functioning right kidney. After a week's rest, we easily removed the left kidney, which is shown in Figure 10, as a completely calcified tuberculous kidney of the fœtal type. The patient made an uneventful recovery and was sent home in good condition. One month later he returned with complete suppression of urine again and looked quite toxic. Immediate cystoscopy under local anæsthesia permitted us to insert a catheter 25 centimeters in the right ureter and to draw off 400 cubic centimeters of urine in an hour. The catheter was left in and the patient was relieved of all pain. The catheter was withdrawn in 12 hours and thereafter he passed his urine normally for a week, while resting in bed. We then cystoscoped him and we were able to introduce 40 cubic centimeters of 15 per cent thorium which showed in the X-ray as in Figure 11. The operating cystoscope was then introduced and with flexible scissors the hypertrophied band of muscle overlying the intramural portion of the ureter was cut. The catheter was still in position and care was taken to keep from cutting through the mucosa of the ureter. The operation was similar to that devised by Rammstedt for pylorospasm in infants. The patient has so far had no further attacks.

ETIOLOGY

I do not feel sure of the etiology of this condition. There may be several factors at work. In some cases I suspect a congenitally

Fig. 10.—Photograph of left kidney removed from Case 5.

strictured opening which may be completely closed at times by the ordinary muscle surrounding it. In some cases where the bladder muscle shows trabeculation, cordal lesion due to syphilis or other cause may be the etiological factor. The major group of cases comes, in my opinion, under the heading of spasm due to fatigue and nervous exhaustion. This group should be compared with spasm as seen in other organs—such as the lower end of the œsophagus, the pylorus, ileocæcal valve, the anus, or even the lumbar spasm of lumbago. All of these conditions are noted when the victim becomes run down or nervously exhausted. The attack may be precipitated by the passage of irritating urine, infection, small stones, or crystals.

TREATMENT

During the acute pain, morphia and heat are necessary as in any renal colic. Then complete rest in bed until relaxation is reestablished. Fluids should be forced to keep the urine non-irritating. Should the spasm continue long enough to cause pyelitis, immediate suprapubic incision into the bladder should be done and both ureteral openingt widely dilated with sounds. (Of course this applies only when the ureters cannot be dilated through a cystoscope.) Should the X-ray pictures with a shadow-making fluid show the ureters to be widely dilated and marked pyelitis and parenchymal deficiency

Fig. 11.—Case 5. Roentgenogram of right ureter and kidney after introduction of 45 cubic centimeters of 15 per cent thorium.

exist as in Cases 1 and 4, I believe a complete destruction of the ureterovesical valve should be done. Should the ureter show only moderate chronic distention and the urine be free from pus and the kidney show good function, I believe the operation should be to cut the muscles down to the mucosa—thus leaving the valve intact, as in the Rammstedt operation for pylorospasm.

PROGNOSIS

Should the obstruction continue, hydroureter hydronephrosis, infection, stone formation and destruction of renal parenchyma follow. The results of the operative procedures which I suggest are problematical, as my work has been too recent to draw positive conclusions.

I wish to express my gratitude to my associate, Dr. Bernard Spillane, for his very helpful co-operation in this work.

A CONTRIBUTION TO THE STUDY OF THE EFFECTS OF RADIUM UPON RABBIT OVARIES[1]

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THIS work was attempted with the idea of demonstrating the effects of a given standard dosage of radium upon rabbit ovaries.

A review of the current medical literature revealed only one article devoted exclusively to this subject, that of Dr. John M. Maury,[2] in which he concludes that neither the large nor the small graafian follicles of rabbit ovaries were influenced by a radium dosage of 600 milligram hours. This conclusion being quite the opposite of the generally accepted belief, we undertook our series of experiments with the idea of perhaps throwing further light on this particular subject.

In performing these experiments we have kept as many factors constant as possible. The dosage of radium used was always 600 milligram hours, that dosage being selected because it is conceded by most authorities that 600 milligram hours of radium applied intra-uterinely will be usually sufficient to produce an amenorrhœa for several months, and sometimes permanently; the generally accepted theory being that this result is due to the fact that the radium-rays destroy all the maturing follicles most advanced in development, and the return of menstruation occurring because the more immature follicles had not been destroyed. When these matured, menstruation resulted. But this explanation is contrary to the biological law which states that the less mature the cell, the greater its susceptibility to disintegrating influences.

For most of the exposures we used 50 milligrams of radium in the form of radium barium sulphate in two 25 milligram tubes, but in a few cases we used 100 milligrams, using in addition four 12½ milligram needles of radium barium sulphate. The radium was filtered with a glass, a silver, and a brass screen, and this inserted in a rubber tube of 1 millimeter thickness to filter out the so-called secondary γ-rays. This method of screening gave us practically only the γ-rays to work with, this, however, being in keeping with most of the radium therapy of the present day. The tubes were then fastened to a lead frame by adhesive, and this fastened by means of adhesive and a wide gauze bandage, as nearly over the rabbit's ovary as we could determine. The wide bandage was used to hold the radium securely in place when the rabbit assumed a squatting posture, and prevent the thighs interposing between the radium and the ovary to be treated. This bandage was applied quite snugly and with the animal well stretched out.

If 50 milligrams were being used it was left in place for 12 hours; if 100 milligrams, for 6 hours; and during these intervals frequent examinations were made to be sure that it had not become displaced.

We endeavored as far as possible to duplicate each experiment. In each of nine rabbits the right ovary was removed, and then at a later date, from 4 to 10 days, the other ovary was exposed to radium. This rayed ovary would then be removed at a certain fixed time, and the sections of the two ovaries compared, the ovary removed first acting as a control. In seven other rabbits the right ovary in each was rayed and then both ovaries removed later at a fixed time for each animal. Sections of the two ovaries were then compared. Finally, both ovaries were exposed to radium in two rabbits and these bred after an interval of 6 weeks to see if they would produce a litter.

When the ovaries were removed they were placed at once in a 10 per cent solution of formalin and kept there from 18 to 24 hours, after which they were put through a series of alcohols to dehydrate and harden them. They were then placed in the paraffin bath,

[2] Maury, John M. The result of exposure of animal ovaries to rays of Radium. J. Am. Med. Ass., 1926, lxxxv, 1711.

[1] Submitted in partial fulfilment of the requirements for the degree of Master of Science of the Graduate College of the State University of Iowa, 1922.

blocked, and sectioned. Sections were made from the center and both ends of each ovary, and as many as 75 to 350 sections made from each. They were stained by the alum-hæmatoxylin and eosin method. The sections were studied with special reference to—

1. The condition of the germinal epithelium.
2. The condition of the ovarian follicles.
3. The condition of the blood vessels as regards the presence of any obliterative endarteritis.
4. The condition of the interstitial cells.

The ovary of a rabbit differs considerably from a human ovary. Around the periphery is a single layer of germinal epithelial cells. Beneath this is a rather dense, connective-tissue cortex in which are located the ova in the various early stages of development, and as the follicles increase in size they encroach upon the interior of the ovary. The remainder of the ovary is composed of large, epithelial cells in a usually scanty connective-tissue frame-work, through which the blood supply is carried. The amount of fibrous connective tissue in rabbit ovaries varies considerably.

The ovaries in a rabbit are quite uniformly placed in either flank, and suspended from the dorsal wall by a short mesovarium. They lie a short distance above the crest of the ileum, and a short distance below the kidney. There is quite a variation in their size, but does that have had numerous litters have the largest ovaries. One ovary is often larger than the other. Except perhaps the cæcum, which may and may not intervene, there is very little tissue lying between the radium and the ovary to be treated, so that the radium-rays could reach the ovary much easier than they could when placed intra-uterinely in the human. I do not think that the radium was over one and a quarter inches distant from the ovary in any of these cases, and I would place the average at a much smaller distance than that.

It was necessary to study a great many sections from presumably normal rabbit ovaries in order to learn the histology that might be found. As in other animals, a great many graafian follicles in the rabbit ovaries never reach complete development, this being especially true in the rabbit because in these animals ovulation occurs only with copulation. So that there are always a number of follicles undergoing normal atresia. In rabbits, ovulation occurs from 9 to 10 hours after copulation, and the graafian follicles will not rupture and discharge the ovum unless copulation has taken place. This made it necessary to distinguish between normal atresia and the degeneration of the follicle that might be caused by radium action, provided that the latter had such an effect. The following paragraphs taken from an article by Walter Heape, entitled "Ovulation and Degeneration of Ova in the Rabbit,"[1] describe the normal degeneration of the follicle.

"The follicle is distended and projects on the surface of the ovary, its outer wall is thin, and the whole structure is very vascular, precisely as is the case with the follicles that do rupture after copulation; but it does not rupture, instead, the surrounding congested vessels rupture and pour their blood into the follicle itself, forming there a clot of blood, in the midst of which the degenerating ovum may be seen for several days. This result causes the brilliant, suffused red color of degenerate ripe follicles at an early stage of the process; gradually the red color is lost and results in a black patch which long persists and which is reduced as time goes on by the absorption of the contents of the follicle.

"The first rush of blood isolates the ovum and its discus proligerus, and subsequently washes away the rest of the epithelium from the walls of the follicle, disintegrates the theca interna, and permeates the meshes of the theca externa."

The intervals taken between the time at which the ovary was exposed to the radium and the time when it was removed for sectioning varied from 9 days to 10 weeks; 4, 6, 8, and 10 week intervals being used for the most part, as the period of maximum activity of the radium-rays is said to be between 6 and 8 weeks. Two rabbits died following their radium treatment from causes not attributable however to the radium, one 9

[1] W. Heape, Proc. Roy. Soc. London, Series B, [illegible]

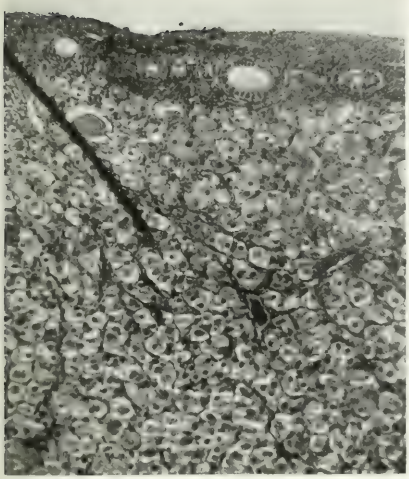

Fig. 1. Section of rayed ovary of Rabbit 1. The nature of the medullary portion of the ovary is well shown, and it is these large epitheliod cells that we have referred to as interstitial cells. In the cortex at about the center is a well-preserved primordial follicle.

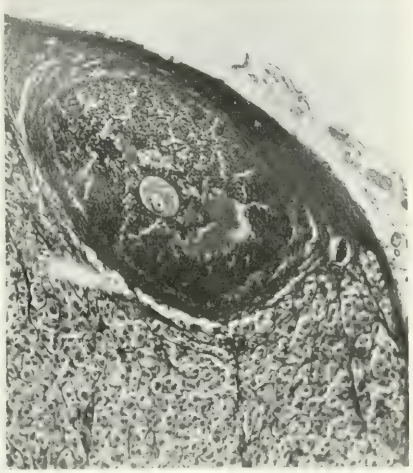

Fig. 2. Section showing a well-advanced graafian follicle with the ovum and its nucleus well shown. The section was made 6 weeks after radium was used.

days, and the other 11 days, following exposure.

In only one case did we find extensive adhesions produced intraperitoneally by the radium, rabbit No. 12 showing marked adhesions beneath the site of the radium between the abdominal wall and the cæcum. This rabbit also had marked hair loss and considerable inflammatory skin reaction, and was one of the rabbits upon which 100 milligrams of radium were used. Practically all of the rabbits showed hair loss, but the extent of the skin reaction varied. The rabbits seemed to show very little reaction to the radium treatments, and ate heartily and ran about the pens the same as usual. But we did find that they developed subcutaneous abcesses over the abdominal and pelvic regions, both the ones that were operated upon and the ones that were not. This is in keeping with the experience of other men who have exposed animals to radium, namely, that the animals practically always develop skin lesions following exposure.

Rabbit 1. Brown doe; weight 8 pounds. On December 13, 1921, 50 milligrams of radium were applied over the left ovary for 12 hours. After an interval of 6 weeks or on January 25, 1922, the rabbit was killed and both ovaries removed. Estimated distance of radium from the ovary 3¼ centimeters. Right ovary measured 25 millimeters long; 10 millimeters in widest diameter. Many follicles were visible on the surface.

The left ovary was 21 millimeters long; and 7 millimeters in widest diameter. Scarcely any follicles were visible on the surface. There was no evidence of any local inflammation around the ovary.

Both specimens were put into 10 per cent formalin solution at once.

Microscopic examination. Left ovary.

1. The sections of the rayed ovary are much the smaller.

2. There is a marked increase in the amount of connective-tissue cortex.

3. The single row of germinal epithelial cells around the periphery of the ovary shows no change as compared to the untreated ovary.

4. There are a few follicles present, but all of them are small and quite immature except 3 which are

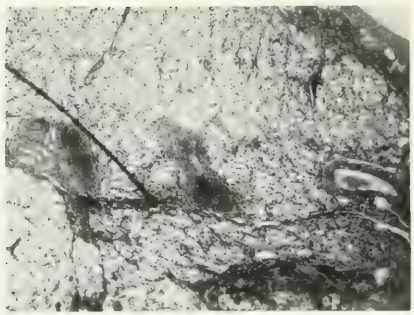

Fig. 3. Section demonstrating the large blood vessels that are found in the rabbit ovary. This section is from the rayed ovary of Rabbit 9. Certainly no obliterative endarteritis is seen in this section.

slightly farther advanced. The entire ovary was sectioned and not one follicle found in the cumulus stage.

5. There is no evidence of an obliterative endarteritis, the blood vessels appearing quite normal.

6. There was not a single corpus luteum in any stage found in the entire ovary. In only one other instance was this observed, and that in Rabbit 18 left, an untreated ovary.

7. There is more connective tissue in this ovary than is usually the case.

8. The large epithelial cells in the interstitial portion of the ovary show no apparent change. They are of normal size, with nuclei round and centrally placed, and show the usual amount of chromatin granules.

Right ovary.

The control ovary. The sections are those of an apparently normal ovary and show follicles in all stages of development, and several corpora lutea.

Rabbit 2. Gray doe; weight 7 pounds. On December 17, 50 milligrams of radium were applied over the right ovary for 12 hours. Both ovaries were removed after an interval of 8 weeks, on February 13. The right ovary looked perfectly normal and showed follicles visible on the surface. It was 14 millimeters long, and 2½ millimeters in greatest diameter.

The left ovary was much larger, measuring 15 millimeters long and 5 millimeters in diameter. About the same number of follicles could be seen on the surface as in the other ovary, the only apparent difference between the two being in size.

Microscopic examination. Right ovary.

1. Sections smaller in diameter than in the untreated ovary.

2. Some increase in the number of cellular elements in the connective-tissue cortex.

3. Germinal epithelium unaltered.

4. Sections from the ovary show some very good examples of maturing follicles. Some sections show as many as five well-advanced follicles with one or more in the cumulus stage, and with the ovum in a very good state of preservation.

5. No evidence of obliterative endarteritis.

6. Occasional corpus luteum seen.

7. No increase in the amount of fibrous connective tissue throughout the medullary portion of the ovary.

8. The interstitial cells show no change.

Left ovary.

Control. Normal ovary, with numerous follicles in various stages of development.

Rabbit 3. Small brown doe; weight 4 pounds. On January 9, 50 milligrams of radium were applied over right ovary for 12 hours. After an interval of 4 weeks, on February 6, both ovaries were removed. Microscopically, no difference could be seen in the two ovaries. Each measured 1 centimeter long, and 3 millimeters in diameter. There were 3 or 4 discolored spots on each, the site of atretic follicles.

Microscopic examination. Right ovary.

1. Both ovaries of equal size.

2. The connective-tissue cortex is wider and appears more dense than in the other ovary.

3. Germinal epithelium unaltered.

4. Half the ovary is occupied by a single follicle. In sectioning the ovary this follicle has been partially destroyed but two slides show the ovum and in good state of preservation. It has advanced to the cumulus stage of the follicle. Numerous other smaller follicles are seen.

5. No obliterative endarteritis.

6. No corpus luteum seen.

7. No increase in the amount of fibrous connective tissue in the medullary portion of the ovary.

8. No change in the epithelial cells of the medullary portion.

Left ovary.

Control. Contains many early follicles and one well advanced. No well-developed corpus luteum seen.

Rabbit 4. Brown doe; weight 6 pounds. The right ovary was removed January 9. It was 1 centimeter long.

On January 16, 50 milligrams of radium were applied over the left ovary for 12 hours. Eleven days later the rabbit had to be killed and the left ovary was removed. It was 1 centimeter long, and looked like a normal ovary.

Microscopic examination. Right ovary.

Control ovary. The sections are those of a normal ovary and reveal numerous graafian follicles in all stages of development.

Left ovary.

1. Ovaries equal in size.

2. The connective-tissue cortex is very narrow in this case.

3. No change in the germinal epithelium.

4. There are not as many ova and follicles in these sections as we usually see. However, some

sections show as many as 4 well-advanced graafian follicles, though they have been mostly destroyed in sectioning.

5. No evidence of obliterative endarteritis.

6. Normal corpora lutea present.

7. No change in the fibrous connective tissue, except the scanty cortex above mentioned.

8. No change in the medullary cells.

Rabbit 5. Tan doe; weight 8 pounds. On January 9, 50 milligrams of radium were applied over the right ovary for 12 hours. On January 16, 50 milligrams were applied over the left ovary for 12 hours. After an interval of 6 weeks, this doe was put in with a buck, and on March 30, produced a litter of 7 normal rabbits, all of which lived.

Rabbit 6. Large Fleming giant doe; weight 14 pounds. On January 11, the right ovary was removed. On January 17, 50 milligrams of radium were applied over the left ovary for 12 hours. Six weeks later, on February 28, this left ovary was removed. It was 12 millimeters long, and 4 millimeters in greatest diameter. Many follicles were visible on the surface.

Microscopic examination. Right ovary.

Control ovary. Sections normal, and show a great many graafian follicles, some of them with two distinct ova.

Left ovary.

1. Equal in size to the right.

2. The connective-tissue cortex was here not as dense as in some of the other rayed ovaries.

3. No change in the germinal epithelium.

4. There are numerous graafian follicles in different stages of development, some sections showing three that are almost ready to rupture. The ovum can be seen in all, well preserved.

5. No obliterative endarteritis.

6. As compared with the opposite ovary there is more fibrous connective tissue present in the medullary portion of the ovary.

7. No change in the interstitial cells.

Rabbit 7. Small brown doe; weight 7 pounds. On January 17, the right ovary was removed. On January 23, the left ovary was exposed to 50 milligrams of radium for 12 hours. Eight weeks later, or on March 20, this ovary was removed. It measured 12 millimeters long, and 6 millimeters in diameter. Microscopically it was normal, and seven well-advanced follicles could be seen on the surface.

Microscopic examination. Right ovary.

Control ovary. The sections are those of a normal ovary with the usual amount of follicle development.

Left ovary.

1. The ovary is almost twice as large as the control ovary.

2. The connective-tissue cortex is a trifle more dense.

3. No change in the germinal epithelium.

4. Well-advanced graafian follicles are not numerous. One large corpus hæmorrhagicum is present,

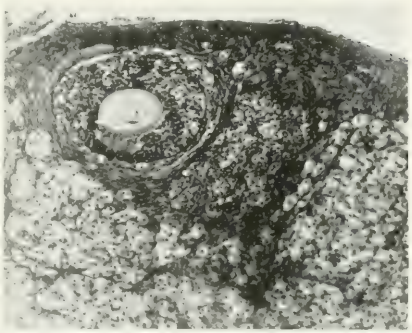

Fig. 4. Section made from the rayed ovary of Rabbit 8, 10 weeks after exposure. It shows a young graafian follicle with the ovum and its nucleus.

and one smaller one. In some sections of the smaller one the corpus luteum can be seen beginning to form, the large pigmented granular cells being present. The large follicle has evidently just begun to degenerate. There are some primordial follicles in good state of preservation, and some farther advanced with ova visible.

5. No obliterative endarteritis.

6. Normal luteal bodies.

7. No marked increase of fibrous connective tissue in the medullary portion of the ovary.

8. No change in the interstitial cells.

Rabbit 8. Small brown doe; weight 5½ pounds. The right ovary was removed January 18. On January 23, 50 milligrams of radium were placed over the left ovary for 12 hours. On April 3, or 10 weeks after exposure, this ovary was removed. It was 12 millimeters long, and 5 millimeters in the greatest diameter. The ovary and surrounding tissues were somewhat injected. On the surface of the ovary a dozen follicles were visible. The position of the radium had been less than an inch from the ovary. There did not appear to be any inflammation in the surrounding peritoneum.

Microscopic examination. Right ovary.

Control ovary. These sections show a great many ova, more than usually seen in the domestic rabbit. The follicles are in all stages of development.

Left ovary.

1. The ovaries are of equal size.

2. Some thickening of the connective-tissue cortex.

3. No change in the layer of germinal epithelium.

4. The treated ovary has far fewer follicles than the right, but such a difference is evidently common in rabbit ovaries. Follicles are found in all stages of development, and all apparently uninjured by the radium. There is one recent corpus hæmorrhagicum in which can be seen the beginning corpus luteum.

Other follicles are seen in the macula stage, one section showing the ovum intact, and with the nucleolus readily visible. There are several follicles not quite so far advanced as the cumulus stage, showing good ova and nuclei.

5. No obliterative endarteritis.

6. Many corpora lutea seen.

7. No increase in the fibrous connective tissue in the medullary portion of the ovary.

8. No apparent change in the interstitial cells.

Rabbit 9. Small brown doe; weight 4½ pounds. On January 18, 50 milligrams of radium were applied over the right ovary for 12 hours. Both ovaries were removed on March 29, 10 weeks after radiation. The right ovary was smaller than the left, and measured 13 millimeters long and 5 millimeters in diameter. It also contained fewer visible follicles than the left. The left ovary measured 12 millimeters long, and 6 millimeters in diameter. The radium had been placed within 2 centimeters of the right ovary.

Microscopic examination. Right ovary.

1. This is the smaller ovary.

2. The connective-tissue cortex appears a bit more cellular than in the left.

3. No change in the germinal epithelial cells.

4. There are follicles seen in all stages of development, but more primordial than well advanced. These younger ova show nuclei and nucleoli in good condition. A few graafian follicles have reached the cumulus stage with the ova and nuclei normal.

5. There is no obliterative endarteritis.

6. Corpora lutea present.

7. There is a slight increase in the amount of fibrous connective tissue in the medullary portion of the ovary.

8. No change in the interstitial cells.

Left ovary.

Control ovary. Sections from this ovary show more ova present in the several stages of development, and some sections show 4 or 5 well-advanced graafian follicles.

Rabbit 10. Brown doe; weight 7½ pounds. Right ovary removed January 30. The pelvic organs were very much injected, and even the small blood vessels bled considerably. On the surface of the ovary are 4 bright red spots, presumably follicles just recently ruptured. The ovary measured 15 millimeters long, and 6 millimeters in diameter.

On February 14, 50 milligrams of radium were applied over the left ovary for 12 hours. This ovary was removed 4 weeks later on March 14. It measured 19 millimeters long, and 8 millimeters in diameter. There were 7 large follicles visible on the surface. It was certainly a normal-looking ovary.

Microscopic examination. Right ovary.

Control ovary. Many graafian follicles present in advanced stages of development. Normal ovary.

Left ovary.

1. Considerably larger than the right.

2. No change in the connective-tissue cortex.

3. No change in the germinal epithelium.

4. It was necessary in this case to section almost two-thirds of the ovary before we could find any graafian follicles in the cumulus stage. A few less matured ova were seen and with nuclei and nucleoli in good condition. All sections, however, were conspicuous for their lack of ova. There were 3 corpora hæmorrhagica of recent origin, their cavities filled with blood.

5. No obliterative endarteritis.

6. Corpora lutea seen in various stages, but very few.

7. Some slight increase in the amount of fibrous connective tissue in the medullary portion of the ovary as compared to the right ovary.

8. No change in the interstitial cells.

Rabbit 11. Small white doe; weight 4 pounds. On February 6, 50 milligrams of radium were applied over the right ovary for 7 hours, and on February 7, for 5 hours more.

On February 10, 50 milligrams were placed over the left ovary for 12 hours.

After an interval of 6 weeks this rabbit was bred to see if she would produce a litter. She was placed with a buck later on also but when killed on May 18, no pregnant condition was found. The ovaries were both very small. The right measured 9 millimeters long, and 1½ millimeters in widest diameter. The left was 8 millimeters long and of the same diameter.

Microscopic examination. Right ovary.—Left ovary. These two ovaries presented a most unusual picture. The connective-tissue cortex was extremely wide and cellular, constituting practically half of the ovary. There were no ova seen in either ovary, and, of course, no graafian follicles. In the right ovary, however, was a newly forming corpus luteum, and some other sections showed another very much older; it was almost a corpus albicans except for some pigmented cells in the center. The germinal epithelium was normal, and the blood vessels showed no change, and the medullary cells were also normal.

Rabbit 12. White doe; weight 6 pounds. On February 28, 75 milligrams of radium were placed over the right ovary for 8 hours.

On May 9, 10 weeks later, both ovaries were removed. There were many adhesions between the abdominal wall and the cæcum beneath the site of radiation. There was also a very marked skin reaction in this case. The left ovary measured 12 millimeters long, and 6 millimeters in diameter. There were 4 follicles visible on the surface.

The right ovary was 18 millimeters long, and 6 millimeters in diameter and showed a great many follicles visible on the surface, many of them hæmorrhagic.

Microscopic examination. Right ovary.

1. Larger than the control.

2. Connective-tissue cortex similar to the left.

3. No change in the germinal epithelium.

4. Through the middle portion of the ovary there were no advanced follicles and only a very few ova

of any description, but at either end there are 3 or 4 large follicles in most every section.

5. No obliterative endarteritis.

6. Through the center of the ovary are three normal corpora albicans.

7. No increase in fibrous connective tissue.

8. No change in the interstitial cells.

Left ovary.

Control. Not many follicles present. Some sections show a corpus hæmorrhagicum recently ruptured, and a graafian follicle approaching the cumulus stage.

Rabbit 13. White doe; weight 8 pounds. Had a litter of seven about 6 weeks ago.

On April 26, 100 milligrams of radium placed over the right ovary for 6 hours. Eight days later this doe gave birth to a litter of ten apparently full-term rabbits. The following day she died of "snuffles" and both ovaries were then removed. This was on the ninth day after exposure.

The right ovary was 22 millimeters long, and 7 millimeters in diameter.

The left ovary was 19 millimeters long, and 7 millimeters in diameter. Both ovaries were normal in appearance and consistency. There was no hair loss as yet.

Microscopic examination. Right ovary.

1. Treated ovary larger in this case.

2. The connective-tissue cortex is the same in each ovary.

3. No change in the germinal epithelium.

4. Four well-advanced follicles observed, the nucleus intact in each. In two of these follicles some hæmorrhage had occurred.

5. No obliterative endarteritis.

6. Normal corpora lutea.

7. No difference in the amount of fibrous connective tissue in the medullary portion of the two ovaries.

8. No change in the interstitial cells.

Left ovary.

Control ovary. Contains one very large corpus luteum which occupies about four-fifths of the diameter of the ovary at that portion. There are 3 large graafian follicles, two of which are evidently atretic, but the third is well advanced in the cumulus stage. Another smaller one was seen, not quite so far advanced but with the ovum and its nucleus evidently unchanged.

Rabbit 14. Small dark gray doe; weight 4 pounds. Right ovary removed February 1. It measured 12 millimeters long and 2½ millimeters in diameter, and though the diameter was relatively small it was otherwise a normal appearing ovary.

On February 14, 50 milligrams of radium were applied over the left ovary for 12 hours. Ten weeks after exposure, on April 25, the left ovary was removed. It measured 12 millimeters long, and 5 millimeters in diameter. Though a small ovary, there were 8 or 10 follicles visible on the surface. Estimated distance of the radium from the ovary 2½ centimeters.

Fig. 5. Section taken from rayed ovary of Rabbit 4. 11 days after exposure to 600 milligram hours of radium. The single layer of germinal epithelium is seen at the periphery. Beneath it is the connective-tissue cortex containing the primary ovary. There are 4 graafian follicles shown here, two of them in the cumulus stage and one almost completely matured. In the two largest follicles the ova are shown. The nature of the medullary epithelium is also well demonstrated.

Microscopic examination. Right ovary.

Control ovary. Apparently normal ovary with several well-advanced graafian follicles.

Left ovary.

1. Larger in diameter than the right.

2. The connective-tissue cortex is wider than in the right ovary and stands out more prominently.

3. No change in the germinal epithelium.

4. The sections show well advanced graafian follicles, some of them with the ovum present and in good condition. In the discus proligerus and surrounding zone we find evidence of rather active mitosis, showing the follicle to be in active growth. Many other less far advanced follicles are seen, ova intact and showing nuclei and nucleoli.

5. No obliterative endarteritis.

6. Normal corpus luteum seen.

7. No evident increase in the amount of connective tissue in the medullary portion.

8. No change in the medullary epithelium.

Rabbit 15. Dark gray doe; weight 7 pounds.

Right ovary removed January 31. Was a normal appearing ovary of the average size, measuring 14 millimeters long, and 4 millimeters in diameter. A number of follicles were seen on the surface.

On February 8, 50 milligrams of radium were applied over the left ovary for 12 hours. This ovary was removed after an interval of 6 weeks, or on March 22. It measured 17 millimeters in length, 8 millimeters in diameter, and was a normal appearing ovary with several follicles visible on the surface.

Microscopic examination. Right ovary.

Control ovary. This ovary does not show very many graafian follicles, but there are a few well advanced in the cumulus stage, and some others not so far along.

Left ovary.

1. The rayed ovary was slightly larger.
2. The connective-tissue cortex is very narrow and not as wide as in the opposite ovary.
3. The germinal epithelium shows no change.
4. Well-advanced graafian follicles in the cumulus stage were not seen. Two corpora hæmorrhagica were found placed close together and filled with blood. Another shows the corpus luteum just beginning to form, with the cells at the periphery of the blood clot filled with yellow pigment, some fibrin being laid down, and early blood vessel formation. Two ova were found in the late primordial stage in a good state of preservation.
5. There is no obliterative endarteritis, and on the contrary this ovary has a very rich blood supply with vessels of large caliber.
6. Corpora lutea present.
7. No change in the amount of fibrous connective tissue in the medullary portion of the ovary.
8. No change in the interstitial cells.

Rabbit 16. Grayish brown doe; weight 9 pounds. Right ovary removed February 15.

On March 1, 100 milligrams of radium were placed over the left ovary for 6 hours. After an interval of 8 weeks, or on April 25, this ovary was removed. It measured 20 millimeters long, and 8 millimeters in diameter. It appeared normal, and 12 to 15 follicles were visible on the surface.

Microscopic examination. Right ovary.

Control ovary. A normal ovary, some sections showing as many as 7 or 8 well-advanced graafian follicles.

Left ovary.

1. This rayed ovary is about 2 millimeters larger in diameter.
2. No difference in the connective-tissue cortex.
3. Germinal epithelium unchanged.
4. Normal well-developed graafian follicles seen, as many as six in a single section, all of them either in the cumulus stage or approaching it. The nuclei are well preserved in these ova, and some show two nucleoli in good condition. There are many primordial ova and one corpus hæmorrhagicum that has just recently been formed and is filled with blood.
5. No obliterative endarteritis.
6. No change in the amount of connective tissue present in the ovary.
7. Normal corpus luteum seen.
8. No change in the interstitial cells.

Rabbit 18. Small dark gray doe; weight 3 pounds. This doe is about 6 months old. On March 13, 100 milligrams of radium were placed over the right ovary for 6 hours. Both ovaries were removed after an interval of 4 weeks, or on April 25.

The right ovary measured 16 millimeters long, and 6 millimeters in diameter, and there were 3 follicles visible on the surface. The left ovary was 14 millimeters long, and 5 millimeters in diameter. It was whiter than a normal appearing ovary and looked rather sclerotic, and not a single follicle was visible on the surface. This was the only ovary examined (except the ovaries in Rabbit 11) where such was the case.

Microscopic examination. Right ovary.

1. The rayed ovary was larger than the control.
2. No change in the connective-tissue cortex.
3. No change in the germinal epithelium.
4. The rayed ovary shows 4 large corpora lutea, evidently perfectly developed. There was one large graafian follicle seen, but it had been partially destroyed by sectioning, as was usually the case with the atretic follicles such as this was. There were a few primordial ova in good condition.
5. No obliterative endarteritis.
6. Normal corpora lutea, as above stated.
7. No change in the medullary portion of the ovary and medullary epithelium.

Left ovary.

Control ovary. Shows no well-advanced follicles at all. There are several in the primordial stage and in good condition. This control ovary and the rayed ovary in Rabbit 1 are very much alike; and one was rayed and the other was not.

Rabbit 20. Large gray doe; weight 11 pounds. Right ovary removed March 14. It was a large ovary and measured 19 millimeters in length, and 8 millimeters in diameter.

Fifty milligrams of radium were applied over the left ovary for 7 hours on March 21; and on March 24, 100 milligrams for $2\frac{1}{2}$ hours, this making a total of 600 milligram hours. This ovary was removed after an interval of 4 weeks, on April 18. It measured 19 millimeters long, and 10 millimeters in diameter. It was a normal appearing ovary with numerous follicles visible on the surface.

The estimated distance from the radium to the ovary was not over 24 millimeters.

Microscopic examination. Right ovary.

Control ovary. No completely matured graafian follicles in these sections, but there are a few approaching the cumulus stage, and there are several primordial ova.

Left ovary.

1. The length of both ovaries was the same but the rayed ovary was larger in diameter.
2. The connective-tissue cortex of the rayed ovary is wider and more cellular.

3. Germinal epithelium unchanged.

4. Many sections show as many as 5 graafian follicles well advanced in the cumulus stage and almost mature. Some sections were cut through an ovum which is shown in good condition. The primordial ova are also unharmed.

5. No obliterative endarteritis.

6. Normal corpus luteum.

7. The medullary portion of the ovary shows the normal amount of fibrous connective tissue.

8. No change in the interstitial cells.

Finally, one guinea pig was rayed with 350 milligram hours over the right ovary. Six weeks later the pig was killed in order to remove both ovaries. Upon opening the abdomen we found the left uterus pregnant with a fœtal pig practically at term. In the right uterus we found a small amount of pus, and a small placenta that measured 10 millimeters in diameter, but no fœtus.

The radium had been applied very shortly after the pig became pregnant and evidently a missed abortion had taken place in the right uterus, probably due to the action of the radium on the endometrium, or perhaps on the true corpus luteum.

Sections of these pig ovaries showed evidently normal ovaries, each containing a great many well-matured graafian follicles, and large corpus luteum. There had been no cessation on the part of the maturing ova in spite of the pregnancy.

SUMMARY

1. In none of the ovaries could we see any change in the single row of germinal epithelium after exposure to radium.

2. We saw no evidence of any obliterative endarteritis in the rayed ovaries, and the blood vessels in the ovary are for the most part quite large and any change occurring in them should be readily noticed.

3. Very little information can be gained by comparing the sizes of the rayed and control ovaries. In five rabbits the ovaries were of equal size; in three the rayed ovaries were the larger.

4. Six ovaries showed little or no change evident in the connective-tissue cortex; but ten others showed an increase in the number of cells in this area, and four showed a definite widening of this zone.

5. As to the effects of the radium upon the ova and maturing graafian follicles we have no evidence in these sections to prove that they have been affected. Certain it is, that the young and early maturing ova have not been harmed. And while we have no evidence here to show that the radium actually destroys matured follicles, it is in these follicles that the most active cell division is taking place, especially in the region of the discus proligerus, and such being the case, one might easily imagine these many newly formed cells being more susceptible to radiation. But the sections of these ovaries were not made, in the earliest case, until 9 days after the radium exposure, and though these particular sections contained well-advanced graafian follicles, still we have no evidence conclusive that others equally matured were not destroyed 36 to 48 hours after the animal was exposed to radium.

In Rabbit 1 the control ovary was quite normal, while the rayed ovary showed no maturing follicles and no corpus luteum in any stage. Without a good knowledge of the normal ovary one might easily have assumed that the radium was responsible for the lack of follicles.

In Rabbit 18 the two ovaries show practically the same histological pictures except that the control ovary contained no corpus luteum in any stage. Neither ovary contained a well-advanced graafian follicle.

Rabbit 15, though showing a scarcity of ova in both ovaries, showed three large recently ruptured corpora hæmorrhagica in the rayed ovary, which had not been removed until 6 weeks after radiation. The control ovary had been removed before any radium had been put on the rabbit, but it failed to show as much activity in the follicles as the rayed ovary; so that the scarcity of follicles in the latter can scarcely be attributed to the radium rays.

The ovaries of Rabbit 11 contained no follicles or ova and for the exception of a corpus luteum and a corpus albicans there is no evidence to show that these ovaries ever have been active. The rabbit is young but that alone would not explain the condition. But there is no evidence of any necrosis or inflammation, the blood vessels are normal, and neither the medullary epithelium nor the germinal epithelium show any change. The amount of fibrous connective tissue in these two ovaries was out of all proportion to the amount usually seen, and one could very well call these sclerotic ovaries.

The remainder of the rayed ovaries all showed a normal histology, with ova in all stages of development.

In explaining the absence of well-advanced graafian follicles in some of the ovaries above mentioned, the following suggestions can be made. Both ovaries need not necessarily be in the same cycle of activity—one ovary being active and containing well-advanced graafian follicles, while the other may be in its period of rest and not producing matured ova at that particular time.

Most of the does were kept separate from the bucks and it has been shown that if the buck is withheld from the doe during several periods of œstrus, most, if not all the older, and many younger follicles, undergo degeneration. The loss of ova from this cause is so great that frequently during the remainder of the breeding season and sometimes apparently for one or more future seasons, the animal is sterile.

6. The fact that in some of the rabbits 50 milligrams of radium was used, and in others 100 milligrams, did not produce any notable difference, except that where 100 milligrams was used there was usually a greater skin reaction. The one case in which 75 milligrams was used received a very marked skin reaction, and the adhesions between the cæcum and abdominal wall were very likely due to the skin inflammation.

7. Rabbit 13 had no hair loss up to the ninth day after being rayed with 100 milligrams.

8. As to the effect on pregnancy:

a. Rabbit 5 produced a litter of normal rabbits after each ovary had received 600 milligram hours of radium.

b. Rabbit 11 failed to become pregnant after the same treatment. Microscopic examination of the ovaries showed no ova present.

c. Rabbit 13 gave birth to a litter of ten full-term rabbits on the eighth day after exposure to radium.

d. The right uterus of the guinea pig miscarried following radiation of the right ovary, though the left uterus went on with the pregnancy. The sections of the right ovary, however, were normal.

So from these experiments we feel that we are justified to conclude that 600 milligram hours of radium have no ultimate detrimental effect upon rabbit ovaries.

And from the clinical side of these observations we venture to say that when radium is given intra-uterinely for a case of menorrhagia, for example, the resulting amenorrhœa is not due to the effect of the radium upon the ovarian follicles, but to the effect upon the endometrium which receives a severe burn from the radium. If the burn be extensive enough a permanent amenorrhœa results; and if not so severe, the amenorrhœa persists for only a few months. If this theory is correct, and several of the best authorities on radium therapy are now advocating it, then much that has been written about the effect of radium will have to be rewritten, and the therapy of radium to a large extent revised.

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CONSERVATISM IN THE TREATMENT OF "ESSENTIAL UTERINE HÆMORRHAGE" [1]

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A LARGE group of cases, in which the most characteristic symptom is atypical uterine bleeding, has been described by many authors, including the writer. In the past 10 years, a certain number have been singled out, because of their similarity, and classified as due to disturbances of ovarian or endocrine function. They have been characterized by the absence of any definite pathological process in the uterus.

The symptomatology of this group is not always uniform, but they have sufficient in common, to warrant setting them apart as dependent on some etiological factor not due to a uterine variation. In some, the chief complaint may be a profuse menstruation with no intermenstrual bleeding. This symptom may begin with the inception of the menstrual function or may begin at any time after. The periods may last from 6 to 20 days and be so profuse as to reduce the hæmoglobin to 30 per cent or less.

There are other types in which the menorrhagia is also accompanied by metrorrhagia of rather severe grade, so that the patient gives a history of almost continuous bleeding extending over a period of weeks or months, with but a few days' interval, in which there is no hæmorrhage. There are no other symptoms of any moment.

These cases have been labeled with various names such as "chronic metritis," "fibrosis uteri," "metropathica hæmorrhagica," and "essential uterine hæmorrhage."

Undoubtedly there are differences in the groups included under these names, and it is most essential to classify them more definitely if possible; first to separate the cases from an etiological standpoint and second to group them so as to make the indications for therapy definite.

In studying the pathological material obtained from these cases it was noted that there were two constant findings, one a hypertrophied uterine mucosa and the second a cystic condition of the ovaries. The type of cysts found varied from small atretic follicles to rather large corpus luteum cysts. The ovaries vary in size from slightly above normal to twice the normal. The more detailed account of the histology will be published later.

It was suggested that the lesion in the endometrium was due to the same impulse that precipitated the bleeding and it was further suggested that the cystic condition of the ovary was at least a factor in the etiology.

In a paper published in Surgery, Gynecology and Obstetrics, August, 1920, I made mention of the fact that up to the present our methods of treatment have been most unsatisfactory. The only treatment that has been curative has been some mutilating procedure that removes the uterus or ovaries, or both, namely hysterectomy, or radiotherapy. It was hoped that by some conservative operation on the ovaries, a favorable influence on the abnormal bleeding might be obtained. It was suggested that as the ovaries were probably the seat of the abnormal stimulus, and particularly as the small cysts in them played a rôle, a wedge-shaped excision of the cyst-bearing area, involving about four-fifths of the medulla and about two-thirds of the cortex, would cure the condition. At the time of publication of the article I had had no opportunity to perform the operation, but since that time I have operated upon 9 cases, and my associates at the hospital have several additional cases each. Four of the patients upon whom I have operated I have been able to keep in touch with for about 18 months.

The following is a brief summary of these cases:

Case 1. K. S., age 28, complained chiefly of metrorrhagia and menorrhagia. Periods began at 14,

[1] From the Gynecological Department (Dr. J. Brettauer), Mt. Sinai Hospital.

were always regular until 4 years ago, since which time they have occurred every 10 days to 3 weeks. The duration is from 6 to 10 days and very profuse. There is slight pain during the early days. Patient has been married 7 years, has 2 children, and has had no miscarriages.

For the past few years patient has had menorrhagia. Periods occur every 10 to 21 days, last 6 to 10 days, and are very profuse. Physical examination is negative except for the pelvic examination which shows bilaterally enlarged cystic ovaries.

Operation, August 29, 1920. Curettage and partial resection of both ovaries. Pathological report: Uterine mucosa shows marked hypertrophy. Ovaries microcystic with some large pea-sized cysts, mostly follicular in origin. After 5 weeks the periods returned. The first one lasted 6 days and was rather profuse. Since then the periods have returned every 4 weeks with moderate flow and no pain.

Case 2. Y. B., age 36, complained chiefly of menorrhagia. The past history is irrelevant. Menstruation began at 13. The periods have been regular, occurring every 28 days until one year ago. Patient has been married 12 years, has 5 children, and had a miscarriage 1 year ago. For the past year the periods have occurred every 3 weeks lasting 10 days and have been very profuse in character. There has been no intermenstrual bleeding. Physical examination is negative.

Operation, August 20, 1920. Curetted. Hypertrophied endometrium was obtained. Patient was again seen 3 weeks later, when she had been bleeding for 10 days, very profusely. Examination was negative except that the left ovary was felt enlarged and cystic. Operation: Partial resection of both ovaries.

Pathological report: Right ovary normal, left ovary shows microcystic condition mostly due to follicular atresia. Several small old corpora lutea are seen. November 22, 1920, period lasted 4 days, first 2 days profuse. Since then periods have been normal, every 26 days, duration 4 days.

Case 3. F. S., age 33, complained chiefly of metrorrhagia and menorrhagia. The past history is irrelevant. Menstruation began at 13, was of 28-day type, and of 5 days' duration. Patient had been married 11 years, has 4 children, had 2 miscarriages, the last one year ago. For the past year patient has had profuse periods lasting 10 days with occasional bleeding between periods. Physical examination is negative except for the local findings. The cervix was eroded, the uterus was enlarged uniformly to the size of a 6 weeks' gravidity.

Operation, October 18, 1920. Bilateral partial resection of ovaries. Pathological report: Microcystic ovaries of atretic follicular type with one small corpus luteum cyst.

December 10, 1920. Period was of 5 days' duration occurring 4 weeks after operation and was very scant. Since then periods have occurred every 3 weeks for 5 days and are scant in quantity.

Case 4. J. K., age 36, complained chiefly of metrorrhagia. Past history is irrelevant. Menstruation began at 14, was of 28 day type, duration 4 days until 1 year ago. Patient had been married 17 years, has 2 children, no miscarriages. For past year patient has bled profusely for one week starting about 5 days after her regular 4-day period.

Physical examination is negative except for the local findings. There was a moderate cystorectocele. The uterus appeared normal, both ovaries, however, were slightly enlarged and cystic.

Operation, August 30, 1921. Partial resection of both ovaries.

Pathological report: Bilateral microcystic disease of the ovaries of atretic follicular type with one old corpus luteum.

Five weeks after operation period began, duration 3 days, moderate flow. This period type has been maintained up to present time.

Analyzing these cases, without attempting to classify or differentiate them, we find that in 4 cases with profuse atypical bleeding, the uterus was grossly normal, both ovaries were found to be diseased, and that by a partial resection of as much of the diseased areas as was consistent with the maintenance of function, the symptoms were relieved and a practically normal cycle was instituted.

While the number of cases reported is small and the communication is only in the form of a preliminary word, the desire to further stimulate work along this line prompted the writing of this article.

Later, a more detailed description both of the clinical and pathological aspects will be presented.

THE MORPHOLOGICAL HISTOLOGY OF ADENOCARCINOMA OF THE BODY OF THE UTERUS IN RELATION TO LONGEVITY

A Study of 186 Cases[1]

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IN this series of 186 cases of carcinoma of the body of the uterus attention has been directed especially to the study of the degree of malignancy based on the degree of cellular differentiation. The series includes only those cases observed between January 27, 1905, and January 21, 1919, in which specimens were available for study, and could be accurately demonstrated, grossly and microscopically, to be of true carcinoma. The number does not, therefore, include all cases in which hysterectomies for carcinoma of the fundus of the uterus were performed during this period.

It was noted in the records that 855 cases of carcinoma of the uterus were observed between January 1, 1910, and January 1, 1919; 70.3 per cent were in the cervix, and 29.7 per cent were in the uterus.

There are various pathological classifications of carcinoma of the uterus. Kaufmann divides them into those which arise from the surface epithelium, and the more common type, those which arise from the glandular epithelium. Under the latter he classifies first, the so-called adenoma malignum, found most often in the uterus but sometimes in the cervix. These are characterized by a slight amount of stroma, and a predominance of glandular tissue, the cells of which lie in close apposition and are highly differentiated. The second type, the usual form of adenocarcinoma of the fundus, is characterized by areas of apparent duplication of the glands of normal endometrium, while in other areas the true carcinomatous nature of the tumor is evident. The cells in the latter areas have all the morphological characteristics of carcinoma cells and are arranged in a typical gland formation. There is a moderate amount of stroma between the carcinoma cells. The third group is the papillary adenocarcinoma and in it the connective tissue stroma, as in adenoma malignum, is very sparse and the glandular tissue rests on trabeculæ of thin connective tissue. In a fourth group he places the cases of adenocarcinoma solidum in which are seen only few areas with glandular arrangement and large numbers of closely packed undifferentiated cells. The last group comprises adenocarcinomata showing, in the midst of the cylindrical cell masses, cornified cells and even epithelial pearls, not unlike those found in squamous-cell carcinoma of the cervix.

The carcinomata arising from the surface epithelium show marked variation, are very rare, and are found in older persons. The most interesting type is that which covers the entire mucosa as a squamous-cell carcinoma without glandular formation, which may or may not be cornified. The underlying tissues may be infiltrated with small celled, carcinomatous projections, and the surface may be papillary.

Ewing divides carcinoma of the uterus anatomically into a circumscribed and a diffuse group, and says that the diffuse are probably the advanced stages of the circumscribed. Histologically he follows a classification very similar to that of Kaufmann.

Under the histological types of carcinoma of the body of the uterus, Aschoff describes the adenoma malignum, adenocarcinoma, solid or medullary carcinoma, and the squamous-cell carcinoma, adding that in the same carcinoma one or even all types may be present.

Cullen does not divide carcinoma of the uterus into definite groups. He asserts that, while all cases may be grouped under one main heading, the grouping varies greatly in individual cases. He is of the opinion that if the papillary arrangement is the most marked, the origin of the tumor is from the surface epithelium; whereas, when the gland-like arrangement predominates, the process has started first in the glands.

[1] Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Pathology, April, 1922.

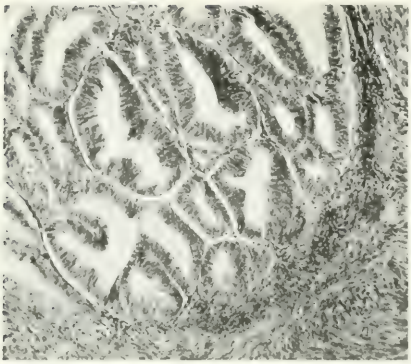

Fig. 1.—Photomicrograph of adenocarcinoma, Grade 1, showing secondary cellular differentiation. Case A140326.

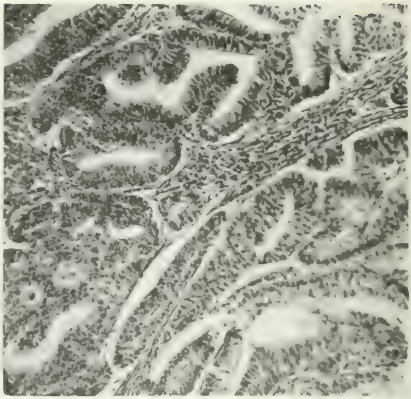

Fig. 2.—Area of an adenocarcinoma showing secondary cellular differentiation. Case A30495.

No special attempt has been made to classify anatomically the cases in this series other than to note the general shape, extent of involvement of the uterine cavity, and invasion of the myometrium in relation to the histological type. From the histological appearance, an attempt has been made to prognosticate the relative degree of malignancy or mortality of a group of cases, taking as a basis the cellular changes. That there are other factors, cannot be denied; such as the rate and extent of growth manifested in the amount of uterine cavity involved, the degree of invasion of the myometrium, the late involvement of lymph nodes, and also the uncertain factor, personal resistance to carcinoma. Many of these factors are not recorded. Cellular differentiation alone does not explain the high mortality of certain carcinomata the cells of which were well differentiated, or the long duration of postoperative life of other patients whose carcinomata were histologically highly malignant. Taken as a whole, however, cellular differentiation appears to be the most important factor.

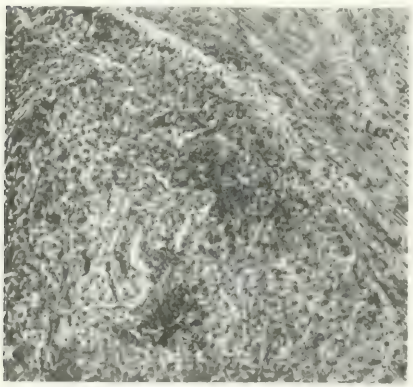

Fig. 3.—Photomicrograph showing primary cellular [illegible]. Case A[illegible].

Each case of the series was studied separately. MacCarty's standard of cellular differentiation was followed. Cells arranged with regard to the general direction of adult tissue or with normal polarity, with normal appearance of cytoplasm and nucleoplasm, and with normal function, that is, completely differentiated, are grouped as showing tertiary differentiation, expressed as Differentiation 3. Differentiation 2 consists of the establishment of tissue polarity but morphological undifferentiation of cells (Figs. 1 and 2). Primary differentiation consists of morphological undifferentiation of cells but alignment according to the general direction of adult tissue (Fig. 3). Thus cells showing no differentia-

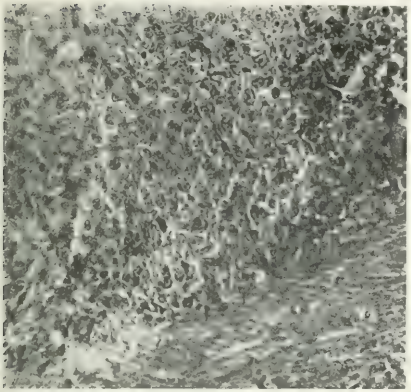

Fig. 4. Photomicrograph of an adenocarcinoma, Grade 4. (Case A190227.)

tion, Differentiation 0, have neither morphoiogical differentiation nor alignment (Figs. 4 and 5).

Appreciating that the degree of malignancy ls dependent on the phenomenon of cellular differentiation, the foregoing types were also incorporated into different grades of malignancy, Grades 1, 2, 3, and 4, similar to Broders' classification of squamous-cell epitheliomas (Figs. 1 to 5). Grade 4 represents highly malignant cases in which the cells show Differentiation 0 throughout practically the entire tumor, although occasional areas may show some primary differentiation (Fig. 5). Grade 3 includes carcinomata showing largely Differentiation 0, some primary differentiation, and occasional areas may show secondary differentiation (Fig. 3). Grade 2 carcinomata show a predominance of secondary differentiation throughout, and occasional areas of primary differentiation (Fig. 2). Grade 1 comprises early cases, in which the carcinoma is extremely small and the cells show high differentiation, secondary throughout (Fig. 1).

The average age of the 186 patients was fifty-five and one-hundredth years, the oldest was seventy-three and the youngest twenty-one (Table I). This bears out statistical data in the literature with regard to the insignificant

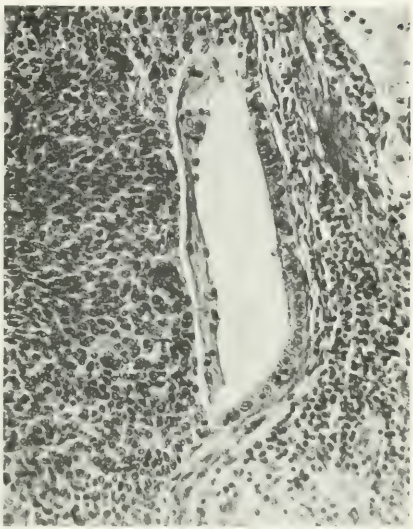

Fig. 5. Photomicrograph of an adenocarcinoma whose cells, having no differentiation, completely surround a normal uterine gland. (Case A274979.)

mortality from carcinoma of the female genital organs before the age of 25 years. Occasional cases of carcinoma of the uterus are cited in the literature in persons younger than 20 years, but the authenticity of most of these is severely questioned. Ganghofner reports a case of cancer of the portio in a girl of 8 years. This case, according to Williams, is not a true carcinoma but a cauliflower excrescence of epithelial hyperplasia; although Chiari examined the tumor histologically, and his report should be authentic. Cragin reports a case of carcinoma of the uterus in a girl of 18 years, on whom a radical abdominal hysterectomy was performed, and recurrence had not taken place during a period of 5 months. In the series of adenocarcinomata of the uterus collected by Cullen the two youngest patients were 30 years.

The average age of patients in the series at menopause was 48.8 years, showing that catamenia is relatively not altered in patients with carcinoma of the uterus (Table I). In

Fig. 6. Papillary type of adenocarcinoma of the body of the uterus cut in sagittal section showing extensive invasion of the myometrium. (Case A91620.)

comparison to the average age, fifty-five and one-hundredths years, one is led to believe that a certain etiologic relation exists between decline of functional activity and malignant disease, and that the liability to cancer increases as the decline of function progresses. This fact is further emphasized when we compare the active marital lives of these patients,

TABLE I. ADENOCARCINOMA OF THE BODY OF THE UTERUS: 180 CASES FROM JANUARY 27, 1905, TO JANUARY 1, 1910

	Years	Number	Percent
Patients		180	
Age:			
Youngest	21		
Oldest	78		
Average	55.01		
Family history of malignancy		27	15.50
Single		18	10.65
Married		108	60.33
Never pregnant		6.5	5.88
Total pregnancies		125	69.12
Pregnancies for each married patient		2.4	
Patients having had miscarriage		53	29.40
Total miscarriages		75	
Miscarriages for each married patient		0.45	
Menopause:			
Youngest	40		
Oldest	78		
Average	48.5		

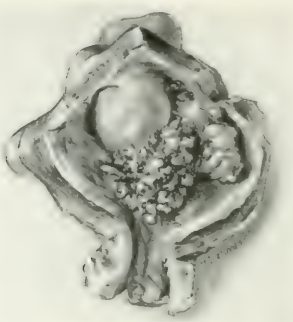

Fig. 7. Papillary type of adenocarcinoma of the body of the uterus associated with fibromyomata. (Case A146326.)

with regard to the number of pregnancies, with otherwise normal patients (Table I).

The longest duration of symptoms occurred in cases of Grades 2 and 3; the longest average duration of symptoms was in the least malignant, Grade 1, and the shortest average duration of symptoms in the most malignant, Grade 4 (Table III). This difference when compared with the extent of involvement of the uterine cavity and the amount of invasion of myometrium (Fig. 6) with regard to the degree of malignancy and cellular differentiation (Tables VI and VIII), illustrates that a tumor of a high degree of malignancy and low cellular differentiation grows larger and invades more extensively in the same period of time, than a tumor of a lower degree of malignancy, and high cellular differentiation. The amount of invasion of the myometrium is designated as

TABLE II. GRADES OF CELLULAR DIFFERENTIATION

	Cases	Percent
Grade 1	11	6.11
Grade 2	103	57.22
Grade 3	54	30.00
Grade 4	8	4.30

TABLE III.—DURATION OF SYMPTOMS ACCORDING TO GRADE OF MALIGNANCY

	Grade 1 Years	Grade 2 Years	Grade 3 Years	Grade 4 Years	All Cases Years
Longest	4	5	4	3	5
Shortest	0.08	0.08	0.1	0.1	0.08
Average	1.5	1.08	1.1	1	1.06

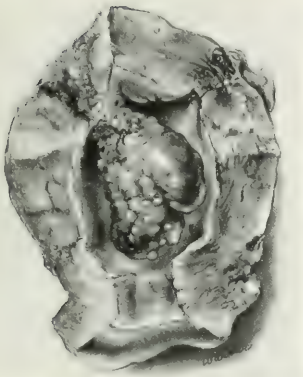

Fig. 8. Polypoid type of adenocarcinoma of the body of the uterus originating in the right horn. (Case A341145.)

Fig. 9. Polypoid type of adenocarcinoma of the body of the uterus of high degree of malignancy. (Case A145635.)

Grades 1, 2, 3, and 4; Grade 1 denotes microscopic involvement of the muscle; Grade 2, invasion of one-half of the approximate width of the muscle; Grade 3, invasion to the serosa, and Grade 4, invasion of all the muscle layer and the serosa.

The clinical symptoms (Table IV) illustrate that vaginal discharge, especially if blood tinged, is the most out-standing feature, occurring in 92.46 per cent of all cases. Loss of weight and strength occupy the next place of importance, while odorous discharge except in advanced cases is of relatively little diagnostic value.

Sixty-one and twenty-nine hundredths per cent of the 186 cases are in Grade 2; 29.03 per cent are in Grade 3 (Table II). In comparison, squamous-cell carcinomata of the cervix, graded similarly by Broders, are more malignant; the larger number of his cases fall into Grades 3 and 4. The number of patients obtaining good postoperative results in Broders' series was 20 per cent, while in this series 61.02 per cent of the patients heard from were still living and the proportion of good postoperative results following vaginal and abdominal hysterectomy was 52.94 per cent and 58.71 per cent respectively. If only the two most malignant grades of carcinoma of the uterus, Grades 3 and 4, are considered, only 35.55 per cent of the patients heard from are living, and good results were obtained in only 32 per cent of the patients operated on. If the larger number of cases of Grade 4 of the squamous-cell carcinomata of the cervix are considered, the difference in percentage of good postoperative results in the two types is further equalized. The differences in life expectancy between the two types of uterine carcinoma and in carcinomata found elsewhere, may possibly be explained by their differences in the degree of malignancy based

TABLE IV.—SYMPTOMS

	Cases	Per cent
Vaginal discharge	182	98.38
Bloody vaginal discharge	171	92.40
Odorous vaginal discharge	53	28.40
Tissue passed	2	1.07
Weight loss (average 20.29 pounds)	44	23.65
Loss of weight and strength (amount not stated)	64	34.40

TABLE V.—ASSOCIATED FIBROMYOMATA, 57 CASES

	Cases	Per cent
Grade 1	8	55.55 of 0
Grade 2	30	30.30 of 99
Grade 3	10	42.22 of 45
Grade 4	3	37.5 of 8
Total	57*	35.4 of 161

*Only this number was available for this study.

TABLE VI.—RELATION OF VARIOUS FACTORS TO GRADE OF MALIGNANCY EXTENT OF INVOLVEMENT OF UTERINE CAVITY, EXPRESSED IN FIFTHS

Involvement	Grade 1		Grade 2		Grade 3		Grade 4		All Grades	
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
1/5	4	44.44 of 9	17	17.00 of 100	4	8.88 of 48			25	15.55 of 162*
2/5	3	33.33 of 9	13	13.00 of 100	4	8.88 of 48	1	12.50 of 8	21	12.96 of 162
3/5			12	12.00 of 100	9	20.00 of 48	1	12.50 of 8	22	13.58 of 162
4/5	2	22.22 of 9	34	34.00 of 100	18	33.33 of 48	1	12.50 of 8	52	32.09 of 162
			24	24.00 of 100	13	28.88 of 48	5	62.50 of 8	42	25.93 of 162
Grade				INVASION OF MYOMETRIUM						
1	6	66.66 of 9	27	27.27 of 99	7	15.55 of 45	1	12.50 of 8	41	25.46 of 161*
2	3	33.33 of 9	36	36.36 of 99	16	35.55 of 45	3	37.50 of 8	56	34.78 of 161
3			23	23.23 of 99	10	22.22 of 45			33	21.73 of 161
4			13	13.13 of 99	12	26.66 of 45	4	50.00 of 8	29	18.01 of 161
				SHAPE OF LESION						
Papillary	4	44.44 of 9	78	78.78 of 99	31	68.88 of 45	4	50.00 of 8	118	73.29 of 161*
Diffuse	1	11.11 of 9	12	12.12 of 99	10	22.22 of 45	2	25.00 of 8	25	15.52 of 161
Polypoid	4	44.44 of 9	9	9.09 of 99	4	8.88 of 45	2	25.00 of 8	18	11.18 of 161
Grade				LYMPHOCYTIC REACTION						
1	7	70.00 of 10	45	39.50 of 114	23	42.59 of 54	3	37.50 of 8	78	41.93 of 186
2	3	30.00 of 10	47	41.22 of 114	21	38.88 of 54	2	25.00 of 8	73	39.24 of 186
3			20	17.62 of 114	10	18.51 of 54	3	37.50 of 8	33	17.74 of 186
4			2	1.75 of 114					2	1.07 of 186
Differentiation				CELLULAR DIFFERENTIATION						
0							3	37.50 of 8	3	1.61 of 186
1			2	1.75 of 114	30	55.55 of 54	5	62.50 of 8	37	19.87 of 186
2			112	98.24 of 114	24	44.44 of 54			146	78.49 of 186

*Only this number of 186 cases were available for this study.

on the cellular differentiation. Such factors as the lymph drainage, mode and extent of invasion, and rapidity of growth may be secondary to, and perhaps to a degree dependent on, cellular differentiation, and in reality of little real importance with regard to the potential malignancy of the carcinoma.

Taussig found that of forty-five cases of carcinoma of the fundus of the uterus, ten (25 per cent) were associated with fibromyomata. The percentage in this series is somewhat higher for the reason that it includes even the most minute intramural fibromyoma (Table V). That this is a factor in the etiology of carcinoma can hardly be accepted when compared with the number of fibromyomata found in non-malignant uteri at hysterectomy and the overwhelming number of fibromyomatous uteri compared with carcinomatous uteri.

TABLE VII.—CELLULAR DIFFERENTIATION OF 186 CASES

	Cases	Per cent
Differentiation 0	3	1.61
Differentiation 1	37	19.89
Differentiation 2	146	78.49

The shapes of the lesions (Tables VI and VIII) to a certain extent appear to be dependent on cellular differentiation. The carcinomata in the least malignant group and those showing the greatest differentiation were largely papillary or polypoid in shape (Figs. 7, 8, and 9), while the most malignant and those showing the least cellular differentiation were those designated as the diffuse or flat type (Fig. 10), as distinguished from the papillary or polypoid types which are raised above the surface of the uterine mucosa. In carcinomata of the bladder, those of the papillary type are less malignant than the flat type. However, other factors, such as mechanical pressure, play a part in determining shape, especially in tumors growing in cavities. Likewise polypoid tumors are surface tumors arising from a local hyperplasia which tends to be non-invasive.

In the general ultimate results according to the four grades of malignancy (Table VIII) all patients with Grade 1 malignancy are still living, while those with Grade 4 malignancy are dead. Referring to the cause of death of these patients (Table XII), 75 per cent died of

carcinoma. Of patients with Grade 2 malignancy, 71.76 per cent are still alive, while in Grade 3, only 38.09 per cent are alive. The cause of death due to carcinoma in these two groups is 62.06 per cent and 74.19 per cent, respectively. Thus not only the number of patients dead increases as the degree of malignancy increases, but the number of deaths due to carcinoma increases.

These facts are likewise verified in a consideration of the ultimate results of the cases grouped on a basis of cellular differentiation. The highest, Differentiation 2, showed the largest percentage of living patients (65.78 per cent) and the smallest number dead (34.21 per cent); while the next group showing primary differentiation as the highest degree of cellular differentiation had the smallest number of living patients (36.36 per cent), and the largest number dead (63.63 per cent) (Table XII). The average duration of symptoms and the average length of postoperative life are somewhat longer in the group showing the highest cellular differentiation.

Abdominal hysterectomy was performed on 136 (73.11 per cent) of the 186 patients, while forty-five (24.19 per cent) had vaginal hysterectomies (Table X). More than one-half of the patients who were thus treated had good results, and are living, or death has resulted from some cause other than carcinoma. The

Fig. 10. Diffuse type of adenocarcinoma of the body of the uterus associated with fibromyomata. (Case A335600.)

TABLE VIII.—RELATION OF VARIOUS FACTORS TO CELLULAR DIFFERENTIATION EXTENT OF INVOLVEMENT OF UTERINE CAVITY, EXPRESSED IN FIFTHS

	Differentiation 0		Differentiation 1		Differentiation 2		Total	
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
1/5			2	6.66 of 30	22	17.18 of 128	24	14.90 of 161*
2/5			5	16.66 of 30	17	13.28 of 128	22	13.66 of 161
3/5			7	23.33 of 30	16	12.50 of 128	23	14.28 of 161
4/5			7	23.33 of 30	45	35.15 of 128	52	32.29 of 161
5/5	3	100 of 3	9	30.00 of 30	28	21.87 of 128	40	24.84 of 161
Grade			INVASION OF MYOMETRIUM					
1			5	16.66 of 30	36	28.12 of 128	41	25.46 of 161*
2	1	33.33 of 3	11	36.66 of 30	46	35.93 of 128	58	36.02 of 161
3			6	20.00 of 30	27	21.09 of 128	33	20.49 of 161
4	2	66.66 of 3	8	26.66 of 30	19	14.84 of 128	29	18.01 of 161
			SHAPE OF LESION					
Papillary	1	33.33 of 3	10	53.33 of 30	101	78.90 of 128	118	73.29 of 161*
Diffuse	2	66.66 of 3	8	26.66 of 30	15	11.71 of 128	25	15.52 of 161
Polypoid			6	20.00 of 30	12	9.37 of 128	18	11.18 of 161
Grade			LYMPHOCYTIC REACTION					
1	1	33.33 of 3	14	37.83 of 37	63	43.15 of 146	78	41.93 of 186
2	1	33.33 of 3	14	37.83 of 37	58	39.72 of 146	73	39.24 of 186
3	1	33.33 of 3	8	21.62 of 37	24	16.43 of 146	33	17.74 of 186
4			1	2.70 of 37	1	0.68 of 146	2	1.07 of 186

*Only 161 cases were available for this study.

TABLE IX. CLINICAL DIAGNOSES IN 180 CASES OF CARCINOMA OF BODY OF UTERUS

	Cases	Per cent
Definite	75	41.32
Questionable	36	19.35
Diagnosed other than carcinoma of uterus	68	36.55
Diagnosis not recorded	7	3.76

TABLE X. SURGICAL TREATMENT

	Cases	Per cent
Total abdominal hysterectomy with removal of tubes and ovaries	128	68.81
Subtotal abdominal hysterectomy with removal of tubes and ovaries	8	4.30
Vaginal hysterectomy with removal of tubes and ovaries	7	3.76
Vaginal hysterectomy	38	20.43
Curettage	4	2.14
Cautery	1	0.53

TABLE XI.—CAUSE OF DEATH OF PATIENTS WHO DIED AT THE CLINIC

	Cases	Per cent
Peritonitis	5	2.68
Myocardial degeneration	2	1.07
*Pneumonia	1	0.53
Intestinal obstruction	2	1.07
Pulmonary embolism	1	0.53
Operative mortality	11	5.91

*One death from pneumonia followed thoracic hysterotomy one year after hysterectomy for carcinoma of the uterus.

good results in both vaginal and abdominal hysterectomy decrease in percentage as the degree of malignancy increases. With this decrease in percentage of living patients with good results there is a corresponding increase in deaths from operation and recurrence.

It is of interest that in this series vaginal hysterectomy shows a slight increase in the percentage of recurrence both in the number of living patients with recurrence and in the percentage of carcinoma deaths (Table XII). Operative death rate is slightly higher in cases in which abdominal hysterectomies have been performed while the percentage of good postoperative results is somewhat higher than in vaginal hysterectomy.

The classification of cases according to the highest cellular differentiation found throughout the carcinomata, and the grouping according to grades show no difference in the total ultimate results. The latter grouping perhaps gives the pathologist a somewhat larger scope. However, the foregoing facts demonstrate that the postoperative prognosis of a group

TABLE XII.—GENERAL ULTIMATE RESULTS ACCORDING TO DEGREE OF MALIGNANCY

Patients traced. 136 of 180 = 75.11 per cent of 180

	Grade 1		Grade 2		Grade 3		Grade 4		All Grades	
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Patients living	6	100 of 6	61	71.76 of 85	16	38.09 of 42			83	61.02 of 136
Postoperative life		Years		Years		Years				Years
Longest		2.18		15.63		14.30				15.63
Shortest		3.51		3.005		3.35				3.005
Average		7.24		7.27		7.78				7.23
Patients dead (cause other than operation)			24	28.23 of 85	26	61.90 of 42	3	100 of 3	53	38.97 of 136
Postoperative life				Years		Years		Years		Years
Longest				10.76		13.66		1.58		13.66
Shortest				0.33		0.106		0.082		0.082
Average				2.96		1.91		0.750		2.20

ACCORDING TO CELLULAR DIFFERENTIATION

	Differentiation 1		Differentiation 2		Total	
	Cases	Per cent	Cases	Per cent	Cases	Per cent
Patients living	8	36.36 of 22	75	65.78 of 114	83	61.02 of 136
Postoperative life		Years		Years		Years
Longest		11.51		15.63		15.63
Shortest		3.35		3.005		3.005
Average		6.31		7.52		7.23
Patients dead (cause other than operation)	14	63.63 of 22	39	34.21 of 114	53	38.97 of 136
Postoperative life		Years		Years		Years
Longest		13.66		10.76		13.66
Shortest		0.106		0.082		0.106
Average		3.06		2.36		2.71

TABLE XII CONTINUED

CAUSE OF DEATH*

	Grade 1		Grade 2		Grade 3		Grade 4		All Grades	
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Carcinoma			18	62.06 of 29	23	74.19 of 31	3	75.00 of 4	44	67.69 of 65
Carcinoma (?)			1	3.44 of 29	1	3.22 of 31			2	3.07 of 65
Operation	1	100 of 1	4	13.79 of 29	5	16.12 of 31	1	25.00 of 4	11	16.91 of 65
Other than carcinoma			4	13.70 of 29	1	3.22 of 31			5	7.69 of 65
Unknown			2	6.89 of 29	1	3.22 of 31			3	4.01 of 65
Total									65	43.01 of 148

PATIENTS WHO HAD ABDOMINAL HYSTERECTOMIES (136 CASES)

Patients from whom information was received									109	80.14 of 136
Patients from whom information was not received									27	19.85 of 136
Living:										
Good results	3	75.00 of 4	49	65.64 of 68	12	35.29 of 34			64	55.96 of 100
Recurrence			1	1.47 of 68					1	0.91 of 109
Patients dead from operation	1	25.00 of 4	3	4.41 of 68	4	11.76 of 34	1	33.33 of 3	9	8.25 of 109
Other causes			3	4.41 of 68					3	2.75 of 109
Carcinoma			13	19.11 of 68	16	47.05 of 34	2	66.66 of 3	31	28.44 of 109
Unknown			2	2.94 of 68	2	5.88 of 34			4	3.66 of 109

PATIENTS WHO HAD VAGINAL HYSTERECTOMIES (45 CASES)

Patients from whom information was received									34	75.56 of 45
Patients from whom information was not received									11	24.44 of 45
Living:										
Good results	1	100 of 1	13	65.00 of 20	3	25.00 of 12			17	50.00 of 34
Recurrence			1	5.00 of 20					1	2.94 of 34
Patients dead from operation			1	5.00 of 20	1	8.33 of 12			2	5.88 of 34
Other causes					1	8.33 of 12			1	2.94 of 34
Carcinoma			4	20.00 of 20	7	58.33 of 12	1	100 of 1	12	35.29 of 34
Unknown			1	5.00 of 20					1	2.94 of 34

PATIENTS WHO HAD ABDOMINAL HYSTERECTOMIES (136 CASES)

	Differentiation 0		Differentiation 1		Differentiation 2		Total	
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Patients from whom information was received							109	80.14 of 136
Patients from whom information was not received							27	19.85 of 136
Living:								
Good results			5	25.00 of 20	56	63.63 of 88	61	55.96 of 109
Recurrence					1	1.13 of 88	1	0.91 of 109
Patients dead:								
From operation	1	100 of 1	4	20.00 of 20	4	4.54 of 88	9	8.25 of 109
Other causes					3	3.40 of 88	3	2.75 of 109
Carcinoma			9	45.00 of 20	22	25.00 of 88	31	28.44 of 109
Unknown			2	10.00 of 20	2	2.27 of 88	4	3.66 of 109

PATIENTS WHO HAD VAGINAL HYSTERECTOMIES (45 CASES)

Patients from whom information was received							34	75.56 of 45
Patients from whom information was not received							11	24.44 of 45
Living:								
Good results			2	33.33 of 6	15	53.57 of 28	17	50.00 of 34
Recurrence					1	3.57 of 28	1	2.94 of 34
Patients dead:								
From operation			1	16.66 of 6	1	3.57 of 28	2	5.88 of 34
Other causes			1	16.66 of 6			1	2.94 of 34
Carcinoma			2	33.33 of 6	10	35.71 of 28	12	35.29 of 34
Unknown					1	3.57 of 28	1	2.94 of 34

* Information received from relative, home physician or other reliable source

of patients with adenocarcinoma can be determined by a close study of the cellular differentiation of the carcinoma.

CONCLUSIONS

1. The mortality and frequency of carcinoma of the body of the uterus rank within the first two places in carcinoma in the female. Such carcinoma is extremely rare before the age of twenty-five years.

2. Carcinoma of the body of the uterus is found in about 30 per cent of all uterine carcinomata.

3. Apparently a definite relation exists between the decline of functional activity and malignant disease of the body of the uterus.

4. The more active the carcinoma, the shorter the clinical symptoms.

5. Vaginal discharge, especially if blood tinged, is the most outstanding clinical feature of carcinoma of the uterus.

6. The accepted belief of a relatively favorable outlook for carcinoma of the body of the uterus in comparison to carcinoma of the cervix has a pathological basis in that the number of cases which show a high degree of differentiation are in the majority, and the more malignant types are rare.

7. Association of fibromyomata with carcinoma of the uterus does not appear to play an important part in the etiology.

8. The shape of the lesion appears to be related to the degree of cellular differentiation, for the more malignant the carcinoma, the less liable it is to assume a papillary form.

9. A carcinoma of a high grade of malignancy grows larger and invades more extensively in a given length of time, than one of a lower degree of malignancy. Lymphocytic reaction appears more marked in groups showing a higher degree of malignancy.

10. The clinical diagnosis of carcinoma of the body of the uterus, before curettage or hysterectomy, is possible in 40 per cent of all cases.

11. The longest length of life since operation of those patients who are now dead occurred in cases of Grade 2 malignancy, while the shortest occurred in Grade 4. The greatest average length of life since operation of those patients who are now living occurred in cases of Grade 2 malignancy, and the shortest in Grade 3. None of the patients with Grade 4 malignancy are now living.

12. The shortest length of life since operation of those patients who are now dead occurred in Grade 4 and the longest in Grade 2.

13. The shortest average length of life following operation of patients who are now dead occurred in Grade 4 and the longest in Grade 2. Grade 1 contained no patients who are now dead.

14. Grade 1 contains the largest percentage of living patients and Grade 4 contains none, while Grades 2 and 3 contain 71.76 per cent and 38.09 per cent, respectively.

15. The largest percentage of deaths from carcinoma occurs in Grade 4 and a smaller percentage in each group to Grade 1, in which there have been no deaths from carcinoma.

16. Abdominal hysterectomy in this series of cases was performed more often than vaginal hysterectomy and the incidence of postoperative good results among living patients is slightly higher among those having abdominal hysterectomy. The percentage of recurrence is slightly higher in vaginal hysterectomy.

17. The sum total of ultimate results shows practically no variation when interpreted from a basis of relative amount of a definite type of cellular differentiation present in the tumor expressed in Grades 1 to 4, than when the interpretation depends on the highest type of differentiation present in the tissue.

18. A series of adenocarcinomata of the uterus can be so classified according to groups, expressing various degrees of malignancy, that the ultimate postoperative results obtained will vary in direct proportion to the mortality of each group.

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LINGUAL GOITER

By Frank H. Lahey, M.D., F.A.C.S., Boston

THE origin of the thyroid gland is from a single median projection of entoderm from the floor of the upper gut. The anlage occupies the aboral position of a groove between both halves of the second branchial arch. Later this groove is replaced by an oval tubercle called tuberculum thyroideum, at which time the anlage begins to grow downward, the surface of the floor of the mouth becoming deepened and now presenting the foramen cæcum. This remnant represents in the fully developed body the original location of the fœtal thyroid and the entrance of the tube by which it was originally connected with the intestinal tract (upper gut). The single anlage of the tongue, tuberculum linguale mediale, appears much later as a tubercle between the first and second branchial arches and is to be distinguished from the lateral anlagen of the tongue.

The anlage of the thyroid during its development in man descends to its ultimate position on the upper tracheal rings, remaining connected by means of the thyroglossal duct behind with its origin, the point of entrance of the duct being the foramen cæcum. Below it sends out projections of cells, like an alveolar or tubulo-alveolar gland, which form the lateral lobes of the thyroid.

The thyroglossal duct is divided in the second month of intra-uterine life into the superior and inferior portions—the superior extending from the hyoid bone to the foramen cæcum and the inferior portion from the hyoid bone to the isthmus of the thyroid or its pyramidal lobe. This division is brought about by the later development of the hyoid bone, the duct at times being in front of the hyoid, sometimes passing through the hyoid, but usually behind it. These possible locations of the thyroglossal tract are of importance in dealing surgically with persistent and discharging thyroglossal ducts.

With the point of origin of the thyroid in mind, the course of its descent and the knowledge that the thyroglossal tract often persists from the foramen cæcum to the isthmus of the thyroid, the development of masses of thyroid tissue at (1) the foramen cæcum, lingual goiter, (2) within the root of

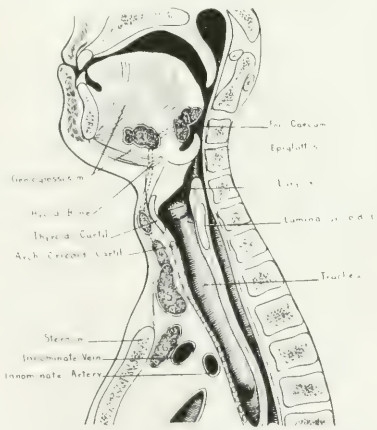

Fig. 1. Diagram showing places at which accessory thyroids may develop. (Course of thyroglossal duct shown by dotted line.) (1) In the region of foramen cæcum; (2) intralingual; (3) prelaryngeal; (4) pyramidal process; (5) normal thyroid; (6) accessory retrosternal thyroid.

Fig. 1. Drawing made from actual tumor before operation.

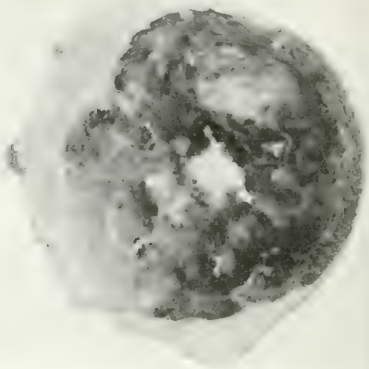

Fig. 2. Photograph of specimen.

the tongue, intralingual goiter, (3) in front of the larynx, prelaryngeal goiter, (4) in the normal location of the thyroid, and (5) as a retrosternal accessory goiter, is readily understood. These latter accessory retrosternal masses of thyroid tissue are said by Corning[1] to be offspring tissue of the thyroid gland which have continued the downward descent of the anlage until they become located in the superior mediastinum behind the sternum.

Lingual goiter, therefore, as may be understood from the foregoing remarks, is the result of development of thyroid tissue at the point of origin of the thyroid. The tumor of the tongue is, of course, present at birth, but as a rule is not of sufficient size to produce symptoms. With increasing years enlargement of the mass occurs until, as in our own case, advice is sought because the tumor, on account of its size, interferes with swallowing and nutrition. The patient complains of the presence of a lump in the back of the throat which on examination appears as a firm, solid tumor located in the midline on the posterior third of the tongue, its surface being dull red in color, slightly lobulated in contour, and bleeding easily if abraded; its base is broad, extending, as a rule, well out close to either edge of the tongue. Because of the mechanical interference with articulation due to the presence of the mass, a definite impairment of speech is produced. Such is the condition in a lingual goiter.

In the case of the intralingual goiter, the condition is very similar, except that it may grow downward into the floor of the mouth.

The treatment is obviously surgical removal when mechanical difficulties in swallowing result from its presence. This may be accomplished in the lingual type by excision through the mouth, care being taken to obtain adequate exposure of the tumor by delivery of the posterior third of the tongue and careful control of bleeding during excision of the mass from the tongue. These two precautions are of extreme importance, owing to the vascularity of the tumor and its inaccessibility except under very complete anæsthesia.

Intralingual goiters arising within the substance of the tongue are reached either through the tongue by way of the mouth, or from the outside, through the floor of the mouth, depending upon whether they are

located close to the mucous membrane of the tongue or well within the substance of the root of the tongue.

The question naturally arises in these conditions as to whether the removal of the lingual goiter will or will not produce myxœdema or tetany. Tetany will not be produced, since the parathyroids possess developmental centers which are entirely independent and separate from that of the thyroid.

The development of myxœdema must always be a possibility, dependent upon whether the lingual goiter represents the development of accessory thyroid tissue in the course of the thyroid tract, or whether it represents the entire undescended thyroid remnant, as apparently was the fact in our case. With the possibility of myxœdema in mind, careful pre-operative and postoperative metabolism estimations should be made, in order that thyroid feeding may be instituted at once upon the appearance of a markedly decreased metabolic rate.

Miss Alice G., age 25, Fall River, Massachusetts. Referred by Drs. G. L. Richards and Jeannette M. Shefferd, Fall River.

The general history and physical examination being negative except for attacks of recurrent appendicitis, are not reported.

Since birth, patient had had a tumor at the base of the tongue. It had gradually increased in size until at the time of examination it was as large as an egg, interfering with swallowing and seriously influencing nutrition. It was located at the posterior third of the tongue at about the situation of the foramen cæcum, and extended back almost to the epiglottis. It was not pedunculated, but had a broad base and was of lobular contour. Its consistency was firm and it was freely movable.

Excision through the mouth was advised, a pre-operative diagnosis of lingual goiter having been made. The pre-operative basal metabolic rate was +2. Operation at the New England Deaconess Hospital on September 2, 1921. Intra-tracheal anæsthesia, Dr. Sise.

Stitches of silk were introduced well back on either side of the tongue and traction made on these until the posterior third of the tongue with the tumor on it was delivered well out into the mouth.

The tumor was then removed from the tongue by wedge-shaped excision, bleeding being carefully controlled by clamps before any portion was cut away. The snaps were then tied with single No. 0 chromic catgut and the mucous membrane of the tongue brought over the defect.

Fig. 1 Histological section of lingual goiter (described in case report)

The patient made an uneventful recovery, but it is of interest to note that on September 14, 1921, 12 days after the operation, her metabolism rate had dropped to −18. She was immediately put upon thyroid feeding, with the result that on November 17, 1921, 2 months later, her metabolism rate had risen to +19.

We again estimated her metabolic rate on July 11, 1922, after thyroid feeding had been omitted for some time. It was found to be −15. The persistent hypothyroidism makes it probable that the lingual thyroid in this case represented the entire undescended thyroid gland.

PRIMARY OSTEOMYELITIS OF THE PATELLA

Report of a Case and a Review of the Literature

By VICTOR E. CHESKY, M.D., Halstead, Kansas

PATELLAR infections of any kind are uncommon, and acute primary osteomyelitis, the infection entering by the hæmatogenous route, is a very rare occurrence.

J. Ducuing, in 1911, reported 73 cases of patellar osteitis collected from the literature in which 50 were tubercular, 2 being bilateral, 15 were spontaneous, 5 traumatic, and 3 syphilitic. His distinction between the spontaneous and the traumatic was that, in the former, the infection was hæmatogenous and in the latter it was carried directly into the patella by trauma. In Gangolfes statistics there are 661 cases of osteomyelitis, 610 of the long bones, 51 of the short and flat bones and none of the patella. Trendel in the Tuebingen clinic, up to 1904, saw 1058 cases of osteomyelitis, 169 of the short and flat bones and only one of the patella. H. Walther reported 2 cases of patellar osteomyelitis in Lexer's clinic from 1910 to 1916. Creite in 1906 reported one case in the Goettingen clinic since 1896, a period of 10 years. Roepke, in the Jena clinic, between 1889 and 1904, reported 8 cases of tubercular osteitis of the patella and only 2 of suppurative osteomyelitis. Konig reported 281 cases of tuberculosis of the knee-joint with 32 involving the patella and none of suppurative osteomyelitis.

This paper discusses only primary suppurative osteomyelitis of the patella of hæmatogenous origin. An effort has been made to collect all the recorded cases. In looking over the literature the meagerness of some of the reports makes it difficult to determine whether the infection was of hæmatogenous origin or whether it was directly introduced through trauma.

The earliest case reported was that of M. Thirion of Namur, France, in 1829. Dr. O. B. Knode reported a case in 1860 which is the second case reported and the first from this country. Coulson, as early as 1853, reported a case of necrosis of the patella with removal, but does not state how the infection took place. The last case reported was that of E. B. Mumford, in November, 1921.

The most extensive writings on this subject are the papers of H. Walther, in 1917, who reported 2 cases and reviewed the German literature up to that date, and J. Ducuing, in 1911, who reviewed the French cases. François, in 1888, also reviewed some of the earlier French cases.

The following is an abstract of 36 cases reported in the literature up to date together with my own case.

M. Thirion. The patient, a male, age 16, in 1828 received a contusion over the upper part of the right leg resulting in rather extensive inflammation and later suppuration. The wound drained but healed in 6 months. Early in 1828 he struck his right leg against a wall. The next day the knee swelled greatly and became hot, tender, and painful. It was treated with poultices. Ulceration of the skin and discharge of pus followed. A year later M. Thirion saw the case. On examination, a probe in the sinus passed through the patella and entered the knee joint. The patient could flex the leg without pain. A crucial incision was made over the patella which was found carious and fragmentary and was removed. The articular ends of the femur and tibia were found normal. The wound was closed with adhesive plaster and healed with very little suppuration, but it was 5 months before the patient could walk with crutches. The final result was a partial ankylosis of the knee-joint.

O. B. Knode. The patient, a male, age 21, fell on frozen ground slightly bruising the left knee. He paid little attention to it but later the knee became swollen, hot, and tender. It was treated with applications until the skin over the patella sloughed. When seen by Knode, in March, 1850, the patient was pale, emaciated, and had a pulse of 120. The dead patella was found in a mass of granulation tissue which sprouted above it an inch high. The entire patella was removed exposing the articular ends of the femur and tibia, which appeared normal. The wound was cleansed, and the knee placed on pillows with the limb partly flexed. In 5 months the wound was healed and knee function was completely restored.

C. Kelly. The patient, a girl, age 7, pricked her finger with a dirty fork. A few days later she had a slight chill and the left knee became painful. The

temperature was high and she showed distinct pyæmic symptoms. Three weeks after the primary injury the knee-joint was opened and discharged a little pus. The finger was also opened and discharged freely. Six weeks later, while dressing the wound, the patella was found lying loose near the surface and it was removed. The bone was yellow in color and had a worm-eaten appearance on its lower border and posterior surface. By this time the finger was healed. She left the hospital 3 months after admission, no new bone having formed up to the date of her dismissal.

Cayley. The patient, a boy whose age is not given, without definite injury or other apparent cause had a painful swelling of the knee followed by the formation of an extracapsular abscess over the front of the knee. This was opened and a piece of dead bone removed from the patella. The joint was not affected. The leg was placed on a back splint and the wound healed well.

M. Gay. The patient, age 13, 4 months before admission had a painful, red swelling of the knee. An abscess formed over the patella and opened spontaneously. The necrotic patella was found in a bed of granulations and was removed. The wound healed rapidly.

François. Case 1. A boy, age 5, was struck in play over the knee. The pain was acute for a short time but the skin was not abraded. He continued to go to school but had pain from time to time. At the end of 2 months fever and violent pain began. An abscess formed over the front of the knee which opened spontaneously and left a sinus. An incision was made and the patella found detached from the underlying tissue. He was discharged with the leg in extension in a silicate cast. After this was removed the knee became stiff, the leg partially flexed.

François. Case 2. A male, age 23, was kicked on the knee by a horse, at the age of 5. Fifteen years later he had to quit his occupation. The knee swelled and the pus was drained away through numerous incisions. The necrosed patella was seen in the depths of the wound and was removed without opening the knee-joint. The joint was stiff at first but motility was finally established until an angle of 80 degrees of flexion could be attained.

W. A. Wright. A boy, age 7, received a blow on the left knee. The joint became swollen, red, and painful. Nine weeks after the injury, the skin over the patella opened and discharged pus, leaving a sinus. An exploring probe led to the patella. An incision was made and a sequestrum was removed from the center of the patella leaving an opening which led to the joint. The knee-joint was opened on both sides draining much serous fluid and coagulated lymph. Three months later the joint was examined under anæsthesia and many adhesions found within it. The remaining patella was firmly fixed to the femur. Some months later the knee was still much swollen and the joint but slightly movable.

T. A. Dodd. The patient, a woman, age 29, 9 months previously without an apparent cause had great pain and swelling of the knee with almost complete limitation of motion. Suppuration afterward pointed over the patella and dead bone could be felt with a probe. The whole patella was found to be necrotic and was removed, the gouge entering the knee-joint. The joint was opened and the articular surfaces found normal. The wound was closed with drainage and healed in 2 weeks. The leg was put in splints for a fortnight when gentle movements were begun. In 2 months she walked painlessly and could bend the knee to a right angle.

B. Walker. A miner was injured about the knee by a fall of coal 2 years previously. When seen he had several sinuses about the knee, one of which led to necrosed bone. The knee-joint was opened and explored, the patella found necrotic and removed. The leg was put on a back splint and the wound dressed with salicylic wool. An erysipelas developed which disappeared in a month. In another 6 weeks healing was complete but the knee-joint was stiff.

A. Shimonek. A boy, age 13, struck his knee on an iron fence causing some pain but not enough to stop his play. That night the joint became very painful, swollen, red, and immobile. Suppuration and spontaneous discharge of pus followed leaving two discharging sinuses on the outer side of the knee. The knee-joint was opened and drained much pus but healed in 2 weeks. A sinus then appeared over the center of the patella leading down to the bone. The patella was first curetted and later counter drainage was established, but the sinus persisted. The necrotic patella was then removed leaving only a cartilaginous rim at the lower border. The wound healed well and passive motion was instituted. In 6 months a new patella larger than its fellow but not quite as thick had formed. Perfect knee action resulted with only a slight limp.

F. Page. A male, age 26, with no history of injury was seen with a large collection of pus around the right knee extending up the thigh. The abscess was opened and drained but a sinus remained over the patella through which bare bone could be felt. Fifteen days later the necrotic patella was removed. The wound healed rapidly and in 15 days he walked out of the hospital without lameness. He experienced only a slight check on arising from a sitting to a standing posture.

Ollier. Case 1. Patient, age 44, at the age of 14 had a painful swelling of the knee. A sinus formed and the knee ankylosed at an obtuse angle. Twenty-five years later without known cause, the knee became inflamed, the skin over the patella ulcerated, showing the patella lying in a granulation-lined cavity. Amputation was done on account of the increasing cachexia. The patellar surface of the femur was eroded, and there was an ankylosis between the tibia and femur.

Ollier. Case 2. A boy, age 9, the next day after bathing in a creek, had a severe pain in the knee and the leg was instinctively held rigid. The pain increased and a large, fluctuating mass appeared over the patella. The skin in the popliteal space

was unchanged. A crucial incision was made, the patella found necrotic, and removed. The patella later reproduced.

Sir J. Paget. A female, age 44, without evident cause, began having pain in the front of the left knee only at night. It was very tender to the touch but only slightly swollen. In 2 months the knee was tender, swollen, and painful. A diagnosis of rheumatism was made, blisters applied, and the nocturnal pain subsided but the swelling remained. Two months later a swelling appeared over the patella which opened and discharged pus. The joint was swollen, puffy, and elastic with a little effusion into the joint. The joint was not tender to pressure or movement and there was only a slight limp. An incision was made over the drainage opening and a hole one-sixth of an inch in diameter was found passing through the bony part of the patella but not entering the knee-joint. The external opening was widened, the cavity packed, and slow healing with perfect knee function followed.

Lannelongue. The patient, age 7, fell on the knee a year previously. He soon had a high fever and the knee became swollen. Suppuration followed, the pus discharging from a sinus over the patella. The wound was enlarged, and the patella found necrosed.

Lannelongue mentions incidentally that he had a case of osteomyelitis of the tibia followed by involvement of the opposite patella.

Nasse mentions two cases seen in von Bergman's clinic, but says that only in one after complete necrosis of the patella it was reproduced and in the other regeneration was not complete but perfect knee function followed.

Duvergey. A man, age 60, suffered a fracture of the hip and gave the following history. At the age of 6 he fell on his left knee. Some days later the knee-swelled and he had high fever. An abscess opened near the head of the fibula and some pieces of dead bone escaped. The wound healed in a year and a half with some limitation of motion of the knee-joint. The patient died a week after his last injury from intestinal obstruction. Autopsy showed the left patella much enlarged, weighing 165 grams while the right weighed 45 grams. The left was irregular in outline but in general conformed to the normal shape.

Berger. The patient, age 50, at the age of 9 got a pain along the inner border of the patella. Nélaton diagnosed tubercle and excised an area of soft tissue but without result. Labbé incised the painful area and used the cautery without results. The patellar area was very sensitive, preventing flexion of the leg and the muscles about the knee began to atrophy. Amputation was considered for relief of pain. The X-ray showed the inner border of the patella roughened and a diagnosis of osteitis was made. The patella was found friable and was excised. A post-operative diagnosis of non-tuberculous osteitis was made.

Trendel. A male, age 29, struck his knee against the corner of a table producing no outward signs of injury. He went on working but next day went to bed with much pain in the knee, and fever. The pain was severe, the fever high and the knee, leg, and thigh were greatly swollen. The knee-joint could be only slightly moved. Incisions were made about the knee which discharged pus and later two sequestra. Sinuses persisted. He was seen by Trendel 5 months after the injury. The leg was flexed at 135 degrees and could be moved passively only 20 degrees. The sinuses were dissected out and a sequestrum removed from the outer edge of the patella. The wound healed in a month but there was no change in the condition of the knee-joint.

W. Roepke. Case 1. A girl, 8½ years of age, fell on the left knee without causing skin trauma. Swelling of the knee followed and 6 weeks later an incision was made along the outer edge of the patella and pus evacuated. The wound did not heal, the fever ran high, fluctuation appeared in the knee-joint, and abscesses formed in the popliteal space and around the head of the tibia. Several sinuses opened around the knee. Eight months after the injury a large loose sequestrum was removed from the center of the patella, and much pus was drained from the knee-joint. Death from meningitis followed.

Roepke. Case 2. A male, age 72, a few days after the amputation of five dry gangrenous frozen toes, noticed a pain along the upper edge of the patella of the opposite leg. A month later this area became swollen and very painful but he had no fever. Eighteen days later the pain was worse and there was effusion into the knee but he had no fever. An incision was made and two small cartilaginous sequestra were removed from the outer side of the patella. By the end of 5 months healing was complete with perfect knee function.

Creite. A male, age 18, 8 days after the onset of an influenza had a painful swelling of the knee and effusion into the knee-joint. The temperature was 39.5 to 40 degrees. The swelling extended up the thigh and the knee was held in partial flexion. A diagnosis of osteomyelitis of the lower end of the femur was made but the inflammatory symptoms subsided and the patient was dismissed. Three months later multiple abscesses pointed around the patella and a large abscess extending up the thigh was opened and drained. Probes introduced did not lead to the femur but to the inner surface of the patella. The knee-joint was opened, it being necessary to chisel the patella from the femur. A sequestrum was removed from the patella. The space between the tibia and femur was filled with connective tissue. The wound healed with little drainage and the patient was sent home in a plaster cast 7 weeks later.

Mueller. Case 1. A boy, age 12, became suddenly ill with a severe pain in the left knee. The next day he had a chill followed by fever and much pain and swelling in the knee. An abscess opened spontaneously but the knee remained painful and the patient did not recover. The knee became swollen, red, and œdematous, and there was definite joint fluctuation.

The fever was 38 to 38.5. A sinus on the anterior side led down to the patella. An incision was made over the patella and a sequestrum was removed. A sinus communicated with the knee-joint, which was filled with pus. The joint was drained in four places. In 6 weeks healing was complete, and the patient had a movable knee-joint.

Mueller. Case 2. A boy, age 12, 4 weeks after the beginning of an osteomyelitis of the calcaneus, had a painful swelling of the knee of the opposite leg. The knee-joint was aspirated and serous fluid containing fibrin flakes was removed. The joint effusion quickly returned and there was much swelling in the patellar region. Two weeks later a sequestrum the size of half an almond was removed from the patella. The infected area communicated with the knee-joint which was drained. In 4 weeks healing was complete with complete restoration of knee-joint function.

Desgouttes and Cotte. A boy, age 12, 2 years previously had a pain in the knee and lower end of the femur. An abscess opened spontaneously, sequestra were discharged, and the wound healed. The knee remained much swollen. The patella was found to be much increased in size. A diagnosis of osteomyelitis of the patella with spontaneous cure was made.

Ludloff. A girl, age 15, with an otitis media following scarlet fever, was stricken with a sudden pain in the right knee. The pain increased without any signs of knee-joint inflammation. It was treated variously without results, and finally put up in spints. When seen by Ludloff, the whole extremity was atrophied, the knee-joint was barely swollen, the knee was almost fixed, and there was loud crepitation on passive movement. Lateral and anteroposterior X-rays showed nothing, but some made at various angles showed a sequestrum in the posterior part of the patella. The joint was opened and found normal, the sequestrum was removed, and the joint closed. The leg was put on a splint with the knee at an angle of 140 degrees. Passive and active motions were instituted and massage given, with the result that the knee action became normal and the atrophy almost completely disappeared.

J. Ducuing. In Ducuing's case a sequestrum the size of an almond was removed from the patella. The wound healed rapidly with perfect restoration of knee-joint function.

F. Partsch. A boy, age 12, 27 days after the onset of a carbuncle of the chin, developed a painful swelling of the right knee. There was redness and fluctuation over the patella. A diagnosis of prepatellar bursitis was made and the bursa was incised 2 weeks later. The wound continued to drain pus and after 2 weeks he could bend the knee only 45 degrees. A probe in the wound touched the bare patella. The X-ray showed the patella in two pieces. This was removed and was found to be necrotic. Complete restoration of joint function followed. Staphlococcus pyogenes aureus was isolated from both the carbuncle and the necrotic patella.

A. B. Elliott. A boy, age 9, had been kneeling in snow slush and the skin for a radius of 3 inches around the patella sloughed, discharging pus and later the anterior necrotic half of the patella. No symptoms were mentioned.

E. M. Sympson. A male, age 73, bruised his right patella by falling on it. Several months later the soft tissues gradually ulcerated and exposed necrotic bone. The anterior surface of the patella was removed, a piece about the thickness of a five shilling piece being separated from the posterior portion by a layer of granulations. Healing was complete in 4 months. The writer says that there was a vertical splitting and subsequent death of the anterior portion.

H. Walther. Case 1. A boy, age 6, struck his knee on a bed. The knee swelled anteriorly with obliteration of the patellar outline. The temperature went to 38 degrees, fluctuation appeared over the patella and it was very sensitive to pressure. A diagnosis of patellar bursitis with effusion into the knee-joint was made. The bursa was found filled with serous fluid and a sinus led down to the bare surface of the patella which was movable. A sequestrum was removed from the anterior surface of the patella and the wound drained. Staphylococcus was cultured from the bone. Two weeks later a suppurative arthritis of the knee-joint made its appearance. The joint was opened and drained. A month later active and passive motion was begun. By 9 months after the original operation, he had active painless movement of the knee from 10 to 168 degrees.

Case 2. A boy, age 11, without apparent cause, had pain, swelling, and redness in the right knee. After poulticing an incision was made over the patella, evacuating pus. The wound healed in 2 months, leaving sinuses. The knee remained swollen and red. The X-ray showed a sequestrum occupying almost the whole patella. An incision opened an abscess in the upper and outer quadrant of the patella and three sequestra were removed. Staphylococci and streptococci were found in the dead bone. In 4 months he had active, painless, extension of the leg through 172 degrees.

E. B. Mumford. A boy, age 5, had a slight injury of the right knee but kept on playing. The next day the knee was swollen, red, and tender over the anterior aspect. Pain on the slightest motion was intense. This was the condition when it was seen by Mumford 2 weeks later except that the pain and swelling were worse and the temperature was elevated. Swelling extended over the front of the thigh with fluctuation over the patellar tendon. X-ray of the femur and patella was negative and aspiration of the knee-joint showed a little bloody fluid free from pus. An incision on the outer side of the patellar ligament evacuated 6 ounces of thick pus. Ten days later dead bone could be felt in the wound. The X-ray at this time showed the bony change. Three weeks after the first operation a large sequestrum was removed from the patella. He was allowed 20 degrees motion from the start and sent home with

Fig. 1. Fig. 2. Fig. 3

Fig. 1. X-ray taken 5 weeks after operation showing practically a total absence of the patella.

Fig. 2. X-ray taken 3 months after leaving the hospital showing beginning regeneration of the patella.

Fig. 3. X-ray taken 15 months after operation showing a large regenerated patella. The tibia is shown in complete extension.

lateral irons to be taken off daily for exercise. Six months later he had flexion of 90 and extension of 180 degrees. The X-ray showed the patella to be a thin plate of bone.

Chesky. A boy, age 9, 6 days before entering the hospital, struck his left knee on a tree stump while riding a bicycle. It produced no visible injury and he gave it no attention. The next morning there was some swelling and pain in the knee. The temperature was 101. The case was treated by his physician as a beginning acute rheumatism. The pain and swelling increased and the temperature went to 102 and 103 daily. He entered the hospital 5 days after the onset. The joint was swollen, hot, red, and very tender. There was an effusion into the knee-joint which was held partially flexed. There was much pain on attempts at passive motion. A diagnosis of suppurative arthritis was made and the joint was opened by Dr. A. E. Hertzler. A yellow serous fluid was evacuated which showed no pus. Drains were inserted and the leg placed on a back splint. Five days later a fluctuating mass appeared over the patella. An incision over this evacuated a considerable amount of thick, yellow pus. The patella was found necrotic and lying loose in the bottom of the abscess cavity, and was removed. The wound was drained. The temperature dropped to normal in a few days, the pain disappeared, and the patient could bend the knee without pain. The first diagnosis was obviously incorrect but fortunately the wound made at the first operation healed without the knee-joint becoming infected before the correct diagnosis was made and the second operation done. Staphylococcus aureus was cultured from the necrotic patella. Five weeks after the second operation the patient was dismissed from the hospital with the wounds practically healed. He walked without pain with some support from a crutch.

An X-ray taken at this time showed only two small indistinct shadows in the patellar region (Fig. 1). The articular surfaces of the tibia and femur appeared normal. Three months after operation he could walk unsupported without pain or limp and could fully extend the leg and flex it through an angle of 135 degrees. An X-ray taken at this time shows a beginning regeneration of the patella (Fig. 2). Fifteen months after operation knee-joint function was perfect and he could walk and run without pain or limp. Figures 1, 2, and 3 show complete extension of the leg and Figure 4 shows complete flexion. He had at this time what appeared to be a completely regenerated patella about one-third larger than the normal right patella but conforming to it in shape (Fig. 3). The X-ray does not show, however, as much bone formation as the examination would lead one to believe.

AGE

Among the 35 cases reported, none occurred before the age of 5 years, 22 from 5 to 15, 6 from 15 to 30 and 4 from 30 to 72. In three of the cases the age was not given. About 65 per cent of the cases, therefore, fall between the ages of 5 and 15. If we throw out some of the cases where the hæmatogenous nature of the

infection was frankly doubtful, and all of these patients were over 15, and Roepke's case, aged 72, which he thinks was infected as a child on account of the cartilaginous nature of the sequestra, together with François' Case 2, the percentage between 5 and 15 is still higher.

Roepke, who worked out the patellar circulation at various ages by injecting the vessels with an emulsion of mercury and taking X-ray plates, showed that before the age of 4 there was practically no circulation. From 4 to 5 ossification began, and the vessels began to appear in and around the ossification center. This circulation rapidly increases as ossification proceeds, reaching its maximum at about the age of 12. At 16 ossification is complete with relatively less blood supply than at 12, and at 30 the blood supply is less than at 16. The vessels come from a plexus over the prepatellar ligament, 5 or 6 small arteries winding through this ligament and entering the center of ossification at the outer border of which they ramify and form fine loops, growing toward the outer edge and posterior surface as ossification proceeds. From an anatomical standpoint, therefore, patellar osteitis of hæmatogenous origin should not be found under 4 or 5 and should become rarer after 16. This conforms very well with the figures given above.

Fig. 4. Photograph taken 13 months after operation showing complete flexion of the leg.

OCCURRENCE

Patellar osteitis is of very rare occurrence. There are several reasons given for this. Some attribute it to the poverty of vascularization, arguing that with a meager circulation there would be much less chance for infective emboli to lodge. Ducuing thinks that, according to Roepke's work, the patella is rather richly vascularized between the ages of 5 and 12 and that the short duration of the vascularization, rather than the poverty of it, is what accounts for the rarity of patellar osteomyelitis. He also says that the density of the spongy part of the patella is 1.30 and that the density of spongy bone in which infective processes especially fix themselves is about 1.15, or according to François, 1.05.

Roepke has shown that the patellar circulation is somewhat like a small shunt on a larger system. The few small vessels that do enter break up into capillaries in a very short distance. The circulation would then be necessarily slow. Emboli in the vessels from which the patellar vessels arise would be more likely to be carried on in the main channel than to be diverted by the slower moving shunt stream.

SEX

Among the cases reported there are 25 males, 5 females and in 5 the sex is not given. This proportion of 5 to 1 is about in accord with the figures of H. Walther and others. It is probably due to the fact that the male being the more active physically is the more likely to receive an injury.

CAUSE

Fourteen cases gave a history of injury, usually slight, about the knee. In 13 cases nothing was said of injury. One followed a finger abscess caused by the prick of a dirty fork, one after bathing in cold creek water, one complicating influenza, one following an

operation for osteomyelitis of the os calcis, one after otitis media, one after a carbuncle of the chin, one after kneeling in snow slush and one following the amputation of frozen toes. The last, Roepke's case, a man aged 72, he thinks was infected in childhood and the infection lighted up by the later trouble and decreased resistance of the patient. Lannelongue mentions a case of osteomyelitis of the tibia followed by an infection of the opposite patella.

Only in four cases was the infective organism given, three showing a staphylococcus and one a mixed staphylococcus and streptococcus. Creite took it for granted that the influenza bacillus was responsible for his case which complicated an influenza. Knowing the association of the streptococus and other pyogenic organisms with the influenza bacillus, he was probably assuming more than was justified.

It is probable, therefore, that trauma, even slight, is a predisposing cause, that it may start in the course of other infections and that the staphylococcus and streptococcus are usually the infective organisms.

PATHOLOGY

The infection starts in the center of ossification, the vessels are thrombosed and the bone already formed dies. The pus points anteriorly first, as posteriorly in the young there is a thick layer of cartilage which forms a rather effectual barrier to knee-joint involvement. This cartilage becomes thinner as ossification nears completeness until in the adult it is only 2.5 millimeters in thickness. In adults then the knee-joint is involved much more readily. The prepatellar bursa is usually involved and the pus discharges at a point directly over the patella or sinuses may open anywhere around the outer edge of the patella. These remain open or alternately heal and open until the sequestrum is removed. Duvergey and Desgouttes report cases in which healing was spontaneous. The pus may burrow upward in the fascial layers of the thigh. There is practically always an effusion into the knee-joint and an inflammatory reaction in the soft tissues of the anterior and lateral aspects of the knee. The popliteal space shows little or no reaction. Untreated cases show a sequestrum, which may comprise the whole bony portion of the patella. This is often found loose in a bed of granulation tissue. In the late untreated cases, the posterior cartilage and synovia may be broken down and the knee-joint infected.

There is a more chronic type in which a low-grade infection may produce a sequestrum and no abscess form. The infection may remain dormant for years until some other condition excites it to activity or a greatly lowered resistance allows it to form an abscess and go on to sinus formation. This type is illustrated by the cases of Roepke's Case 2 and François' Case 2.

SYMPTOMS AND PHYSICAL FINDINGS

The symptoms are pain, which may at first be mild, later becoming of the severe, lancinating type usually referred to the knee, elevation of temperature, rapid pulse, swelling of the anterior and lateral aspects of the knee, tenderness to pressure over the knee-joint but more acute directly over the patella. There is very little or no swelling in the popliteal space and the skin there is often not discolored. There is an effusion into the knee-joint. The leg is usually held fully extended at first but later when the joint effusion becomes marked it is partly flexed. There is marked limitation of motion. Gentle active or even passive motion elicit much pain. Finally the abscess points externally and one or more sinuses form.

The X-ray shows nothing early but when the sequestrum forms this shows in the roentgenograms. This may not show in the anteroposterior or lateral views, as in Walther's case, which he said showed only in plates which were made at various angles.

Ducuing makes the following classification of types: The acute, which is the most frequent, in which the onset is severe and rapid, the constitutional symptoms being marked and in which the sequestrum is formed and the abscess points in from 1 to 3 weeks; the chronic, so called even in the beginning, when it does not present the severe acute phenomena but in which the end-result is the same. Under this form he also speaks of a neurological type but does not explain it. The third is

the prolonged or recurrent type in which the sequestrum forms, the general toxic symptoms are not marked or of long duration and the abscess may not point for years afterward. This type is illustrated by Roepke's Case 2 and François' Case 2.

COMPLICATIONS

Little is said about complications. They are mostly local. Invasion of the knee-joint with suppuration, infection of the prepatellar bursa and abscess formation in the region of the knee are the principal ones. One case was complicated by erysipelas and one died of meningitis.

DIAGNOSIS

In no case was a diagnosis made before the sequestrum had formed and in most of them discharging sinuses were present. The most frequent error is the diagnosing of a suppurative arthritis of the knee-joint. It may also be confused with osteomyelitis of the lower end of the femur and with patellar bursitis.

No case has been reported before the age of 5 and they become less frequent after 15. According to Ducuing, the temperature rarely goes over 102.2°, violent chills and delirium do not occur and only the anterior surface and sometimes the lateral aspect of the knee are deformed, the posterior retaining its normal appearance. The extremity is held straight until effusion into the joint occurs and the greatest pain and tenderness is over the patella and on a level with it. The effusion into the joint is usually not enough to lift the patella from the condyles and it often becomes absorbed when the patient is put to bed. Aspiration of the joint shows a clear fluid negative to bacterial culture. Nasse says that the condition is often recognized by abscess in the bursa and may be diagnosed when prepatellar bursa phlegmon is present. If the sequestrum has formed, the X-ray will make the diagnosis and if sinuses are present, the probe will lead down to the bare sequestrum.

In suppurative arthritis the temperature is much higher, the systemic reaction of chills and delirium is frequent, the entire knee is deformed, the articular depression on both sides and back disappearing. The knee is partly flexed in marked distinction to early patellar osteitis. Pressure on the bottom of the foot causes violent pain which it does not in patellar osteitis. The X-ray shows the patella lifted from the condyles. Aspiration of the joint shows pus and organisms.

Osteomyelitis of the lower end of the femur occurs at the lower end of the diaphysis near the epiphyseal line. The greatest pain and tenderness will be found over the epiphysis. It may occur even in infancy. The constitutional symptoms are marked. The leucocytosis runs from 25,000 to 30,000. Swelling and redness of the soft tissues over the bone soon appear. The knee is held partly flexed.

Prepatellar bursitis is most apt to occur in adults and in those whose occupation subjects the bursa to trauma. The swelling outlines the bursa and there is little constitutional reaction.

TREATMENT

If the diagnosis is made early, incision down to the patella should be made and drainage instituted. If a sequestrum has formed, it should be completely removed, care being taken to preserve the periosteum and posterior cartilage. If the joint is already involved this should be drained. A back splint should be applied. The quadriceps tendon should be kept from retraction. Passive motion should be instituted early and muscular atrophy prevented by massage and exercise. Effusion into the joint always becomes absorbed if infection is not present. Hot applications or baking the joint may, in cases where it has been involved, help secure a greater range of motion. If ankylosis is inevitable the proper position of the leg should be maintained.

PROGNOSIS

There is practically no mortality. One case died of meningitis following operation. If operated upon before the knee-joint is involved and proper after-treatment given, the functional prognosis is very good. Of the 35 cases reported, 13 showed complete restoration of function, 9 showed a partial disability ranging from a slight motility to almost perfect knee action, 4 showed a complete ankylosis, nothing was said about 8 of the cases and

one died. In view of the fact that so many of these were old, neglected cases, one would be fairly safe in assuming that with even a fairly early diagnosis, the functional result would be good in almost every case. Even after joint infection, if drainage is instituted and proper after-treatment given, some have had only slight limitation of motion. Neglected cases where the joint is long involved usually have ankylosis. The patella frequently regenerated, especially in children where the periosteum was preserved.

CONCLUSIONS

Patellar osteitis of hæmatogenous origin is rare compared to osteomyelitis elsewhere. It has never been seen before the age of 5 and is the most frequent between 5 and 15.

Ossification of the patella starts at the age of 4 to 5 and is completed by 16. The blood supply is practically nil before 5, richest from 5 to 15 and diminishes after that age.

There is a frequent history of slight trauma preceding the onset of patellar osteomyelitis.

Abscesses practically always point anteriorly and the knee-joint is involved only in late, neglected cases.

The prognosis as to function is good if operated on before the knee-joint is involved.

The patella is frequently reproduced in children even after complete removal, if the periosteum is preserved.

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TWO EMBRYOLOGICALLY IMPORTANT SPECIMENS OF TUBAL TWINS

Including Critical Summaries of All Known Cases[1]

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INTRODUCTORY

THE uterine tube is occasionally the seat of plural pregnancies. In general, these are separable into three topographical types: (1) all the fœtus may be in one tube (unilateral tubal twin pregnancy); (2) the fœtus may be divided between both tubes (bilateral tubal twin pregnancy); (3) the fœtus may be divided between one or both tubes and the uterus (tubo-uterine pregnancy).

The commonest plural pregnancy that involves the uterine tubes is the combined tubo-uterine type. According to Cameron (1906), Vilsin recorded 65 cases (in 25 of which the tubal fœtus reached maturity!). In 1905 Weibel had collected over 119 cases although it is probable that some of these are merely presumptive and not all are twins. Plural gestation in the same tube is next common. Pulcher (1905) found 18 examples; Costa, in 1907, listed 11 cases which he considered certain and added 15 presumptive cases; McCalla (1909) cites 25 positive cases; Pool and Robbins (1910) give 26 positive cases and reject 18; Hardouin (1919) enumerates 37 as positive and eliminates 13 as spurious. Rarest are bilateral tubal pregnancies. Although McCalla (1909) collected 37 cases and McDonald and Krieger (1913) list 25 proved and 27 probable specimens, less than a dozen of these actually are twins.

NEW CASES OF TUBAL TWINS

Two new specimens of unilateral tubal twins have come under my observation. Each is unique of its kind and both present features of great embryological significance.

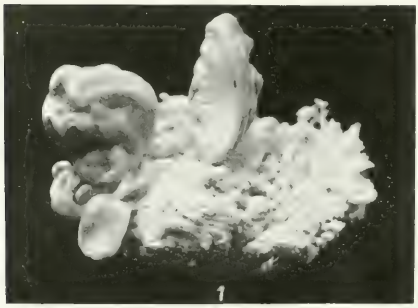
The first new case[2] belongs in the collection of the Carnegie Institution, where it is listed as No. 1126.

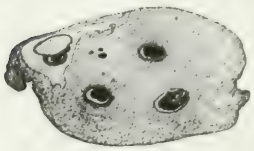
The patient was a married Italian woman, about 30 years old. When medical aid was summoned she had been flowing several days but had considered it her regular period when it began. At operation the right ovary and tube were found normal. The pregnant but unruptured left tube was removed, opened, and its contents sent to the Department of Embryology of the Carnegie Institution. The specimen, when received, consisted of an opened single chorionic sac (22 by 16 by 16 millimeters), attached to which were twin embryos, each 12.3 millimeters long (Fig. 1). This size represents an age of slightly over 6 weeks. The embryos are entirely separate, but apparently enveloped in a single amnion. There is a common yolk sac (Fig. 1) from which two yolk stalks arise near together (Figs. 2 and 3) and enter their respective umbilical cords. The whole specimen is somewhat shrunken, one of the twins more than the other; except for this they appear normal.

The second new specimen came from a young colored woman, 7 weeks past her mensis, who had reached the hospital with symptoms of grave internal hæmorrhage. Her vitality was so low that immediate and rapid interference became necessary. One tube was swollen and ruptured; it was removed. When the undisturbed specimen came into my possession it had been preserved in formalin, and by its own weight the tube had flattened. The broader end, at the point of rupture, was hard with caked clots. In one part of the tube the wall was thin and this was removed to expose the interior (Fig. 4). The single chorionic cavity thus opened measured about 28 by 48 millimeters in its flattened condition. Within were perfectly formed twin embryos, the one at the left in Figure 4 measuring 11.5 millimeters, the one at the right 12 millimeters. Each possessed its own amnion; contained in that part of the amnion of the embryo at the right which was close to the rupture, there is coagulated blood. The embryos have separate umbilical cords inserted in the chorionic wall at a quadrant's distance; the cord of the embryo at the right may be seen in the photograph coursing horizontally to the wall; that of the other embryo passes upward to a flap which formed part of the roof of the sac. Adherent to the amnion of one embryo (at the left in Fig. 4) is a yolk sac, 4.5 by 6.0 millimeters in size; its stalk which joined the umbilical cord has been cut in order to remove the roof of the sac; the remaining stump may be seen in the photograph. The other embryo has no yolk sac. To make certain of this, both umbilical cords were sectioned serially throughout their lengths. That of the embryo on the left

[2] Acknowledgement is due the director, Dr. George L. Streeter, for permission to describe this specimen.

[1] Contribution No. 89.





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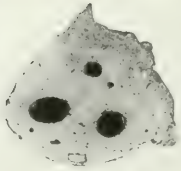

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gave the appearance typical at this age (Fig. 5); the yolk stalk with its vitelline vessels lies in a cœlomic extension; the level of the section photographed is too far distad to include the allantois. The cord of the embryo at the right is without microscopic trace of yolk-sac or -stalk although the remaining structures are normal (Fig. 6).

Both specimens present highly significant features. The first demonstrates for the first time the actual origin of homologous human twins from the same ovum. There has been no real doubt of this, for many facts point incontestably to such a conclusion; as illustrative evidence may be cited their morphological duplicity, their occasional conjoining as "double monsters," and the common chorion. Direct corroboration is furnished by the regular development of single-ovum quadruplets in one mammal, the Texas armadillo, as well as by experiments and observations on the lower vertebrates and invertebrates.

Such single-ovum twins do not arise by the separation of early cleavage cells, as too often has been assumed; on the contrary, the common chorion, which all twins of this sort possess, proves at once that separation must be subsequent to the period when the cleavage mass is differentiated into an inner cell mass and an outer shell of trophectoderm. There exists considerable evidence which supports the belief that the twinning impulse occurs relatively late, at about the moment of gastrulation, which in mammals corresponds to the time of the formation of the primitive streak; the process, then, is simply one of double gastrulation.

The second specimen bespeaks its single-ovum origin about as strongly, for only one yolk sac and stalk are present. Two possible interpretations suggest themselves. It is conceivable that originally there were paired stalks, as in the first specimen described, one of which precociously lost its yolk-sac connection, whereupon it disappeared without trace. On the contrary, the early division of the embryonic mass may have been unequal so that one member received essentially all the material of the future yolk sac, leaving the other from the first with a mere rudimentary "sac"; of special weight in favor of this view is the absence of a second sac, and the missing yolk stalk which persists normally beyond the fourth month even though its union with the gut is usually relinquished in embryos slightly younger than this 6 weeks' specimen. Personally, the writer favors such an early primary separation, rather than a late secondary one with the coincidence of precocious disjunction of the stalk and its simultaneously prompt disappearance. But whichever interpretation is correct, the single-ovum origin is equally well supported.

The primary absence of a distinct yolk sac in one embryo, which is otherwise normal in every way, would further indicate that this organ is not physiologically essential to the growth of an embryo or to the continued differentiation of its parts; indeed, the embryo in question is slightly larger than its twin, whereas both correspond closely in size to the norm for that menstrual age. To be sure, the gut and allantois form from yolk-sac entoderm, yet it is entirely possible that this may occur without a significant sac, as such, ever developing.

The embryo without a yolk sac is of additional interest in relation to the ingrowth doctrine of vasculogenesis which holds that blood vessels, first arising on the yolk sac and elsewhere, invade the embryo as continuous growths. In so far as such evidence is trustworthy, it supports rather the local origin view, now generally acknowledged. That tiny vascular anlages of yolk-sac ancestry actually existed and at an earlier moment helped form primitive vessels by extension into the embryo, is, of course, conceivable; also the theoretical possibility of vascular ingrowths from the early anlages in the body

Fig. 1. Photograph of 12. 3 millimeter human tubal twin embryos attached to a common yolk sac. ×2.3.

Figs. 2 and 3. Additional photographs of the common yolk sac shown in Figure 1. The origin of the separate yolk stalks is apparent. ×2.3.

Fig. 4. Photograph of a pregnant human uterine tube. Part of the wall has been removed to show the twin embryos in place. The single yolk sac belongs to the 11.5 millimeter embryo at the left. The 12.0 millimeter embryo at the right lacks both yolk sac and stalk. ×1.7.

Fig. 5. Photomicrograph of a section through the umbilical cord of the embryo at the left in Figure 4. The yolk stalk lies in a cœlomic extension. The level is too far distad to include the allantois. ×24.

Fig. 6. Photomicrograph of a section through the umbilical cord of the embryo at the right in Figure 4. There is no trace of a yolk stalk. The delicate tube below is the allantois. ×24.

stalk are not excluded because of the characteristic and necessary nutritive relations of the mammalian ovum. Fortunately the fundamental truth of the local origin doctrine rests on observations more rigorously controlled than this natural experiment, which, however, was apparently performed as perfectly as ever may be expected in a higher mammal.

In general the yolk sac of man and the higher mammals appears to be functionally an unnecessary vestige. In the earliest human embryos known, when it might be of real use, it is a simple entodermal sac containing masses of coagulum; growth to a conspicuous size is attained relatively late, long after adequate nutritional relations with the mother have been established.

THE COMPLETE DATA OF TUBAL TWIN PREGNANCY

If the literature of tubal twins be examined it becomes evident that a complete or sufficient presentation of previously recorded cases has never been made. Furthermore, it appears from the perpetuation of inaccuracies and the duplication of accounts that there has been too little recourse to the original literature. For the purpose, therefore, of establishing an available and accurate record I have prepared critical summaries of all existing cases. In each instance the original publication has been examined (the literature covering communications in six languages), and the concise abstracts submitted contain all the significant anatomical information to be had. Omissions, therefore, signify defective original records.

Some old cases, inadequately described, and most doubtless successive pregnancies, are cited in the works of Boehmer (1752), Parry (1876), Schroeder (1888), von Schrenk (1893), Martin (1895), Webster (1896), and v. Winckel (1903–1907). These are omitted from the present enumeration.

The records are divisible into four groups. Thirty-eight cases (excluding the two new specimens) are positive or authentic; eight are probable or presumptive; four are possible but doubtful.[1]

I. POSITIVE CASES

Albertin, 1903. A tumor the size of a fist was found in the thickened wall of the left tube, close to the uterus. Within a single chorionic sac were twin fœtus of about 3 months, each with its cord. *Remarks.* The illustration shows twins of at least 3 months, instead of 2 as estimated by the author. The history indicates their arrest must have occurred nearly a year before the operation.

Amann, 1908. Twins of about 12 weeks contained within separate sacs. *Remarks.* The entire report is in less than two lines yet it cannot be excluded from the positive cases. Pool and Robbins, 1910, and Hardouin, 1919, state that there were separate amnia; however, the phrase in question is "in getrennten Eihoehlen" which appears to refer to distinct chorionic sacs.

Andrews, 1909. A common chorionic sac comprises the ruptured right tube and broad ligament. Apparently a common amnion bulged though the posterior wall of the sac. Within were living male fœtus, of about 14 weeks, attached to a single placenta.

Baldwin, 1913. Two embryos were found in the left and one in the leaking right tube. All three were of the same size and age, "about as large as peas." *Remarks.* Neither patient nor physician suspected pregnancy. One normal menstrual period occurred after pregnancy had begun. This is proved by the size of the embryos which indicates a minimum age of 5 weeks. There is one other positive case of bilateral triplets (Launay and Sequinot, 1911).

Barbat, 1899. The ovarian end of the right tube is a single gestation sac, which had ruptured, expelling twin fœtus, 2½ months old. These had possessed a single amnion and were connected by individual cords to the placenta within the tube.

Basham, 1909. A common chorionic sac in the ruptured left tube. Twin embryos, with individual cords, attach to a common placenta. *Remarks.* From the indistinct photograph the age of the embryos appears to be about 2 months.

Bertino, 1911, 1912. The right tube contains two swellings. One is a hæmatocele, the other a chorionic sac larger than an apple. It shows two operative tears. Within a common amnion are twin male fœtus about 3½ months old, one of which was seen to move. *Remarks.* The description does not make clear whether the tube was ruptured. The photograph (cf. also Bertino, 1912) apparently shows a ruptured point near the hæmatocele.

Braham, 1914. Twin fœtus of about 18 centimeters (5½ months?) were attached by separate cords to a "fused" placenta in a single, ruptured chorionic vesicle. *Remarks.* The author believes one fœtus had been expelled prior to operation.

Brodier, 1896. The ruptured chorionic sac at the ovarian end of the left tube was filled with clots and placental tissue; among these were identical fœtus each about 7½ centimeters long (10 weeks?). *Remarks.* This case was also recorded by Le Dentu, 1896 [illegible] the operation. The two

accounts have previously been listed as separate cases. Le Dentu gives the embryo's age as 7 to 8 weeks; obviously one of these authors is in error.

Cameron, 1906, 1910. Chorionic villi projected through the small perforation of the ruptured and spouting right tube. In the single chorionic sac were twin embryos of about 6 weeks. Separate cords and amnia. Recovery. *Remarks.* Both papers deal with the same case. In 1906 the age of the embryos is given as 5 to 6 weeks, but in the 1910 contribution the age, based on the menstrual history, is placed at about 7 weeks. The true age, deduced from the menstrual history and accompanying illustrations, is obviously about 6 weeks.

Cargile, 1897. A ruptured left tube. Twin embryos were found in abundant clots. *Remarks.* From the history the embryos were probably 8 to 9 weeks old.

Carstens, 1920. The left tube was smooth and unruptured, 2½ by 1½ inches in size. It contained twin embryos, probably 11 millimeters long (6 weeks), within a common chorion. The right tube was ruptured and enlarged sufficiently to admit a thumb even to its uterine end; no fœtus or chorionic tissue was observed. *Remarks.* Some of the details have been gained by personal correspondence. The author is confident that, even in the absence of direct proof, the right tube represents a tubal abortion and in this he is doubtless correct. The twin embryos were "not more than three-fourths of an inch, if they were that long" when straightened out from their original "curled up" position. It is obvious that these statements exaggerate the true size of the embryos as customarily measured. The elapsed time between the last mensis and the operation suggests their age as not more than 6 weeks; if this is correct the true length should not be over 11 millimeters. The author estimates that the right tube "must have been a pregnancy of 6 weeks and the left one of about 3 weeks." For the left tube this is surely an underestimate. One thinks of the possibility of triplets, especially in light of the menstrual history; the author, however, is firm in his belief that the right tube "must have been far more advanced than the left one."

Child, 1907. A ruptured and bleeding left tube, from which twins, each 8 centimeters long (3 months) had been expelled. Single chorion and amnion; individual cords, one broken and its embryo free. *Remarks.* One regular period after the beginning of pregnancy. Last normal delivery was also twins.

Costa, 1907. The tube bore two swellings, well separated, the one at its uterine end the size of a walnut. Internally there is a single chorionic sac constricted into two incomplete compartments; each contains a male fœtus, 5.0 and 5.3 centimeters (10 weeks) respectively. *Remarks.* This specimen illustrates the last stage in a series demonstrating how separate chorionic sacs may fuse (Arey, 1922).

Danforth, 1920. One tube had ruptured in its ampullary region, producing a clot in which were found twin embryos.

Le Dentu, 1896. See Brodier, 1896.

Diamant, 1914. A ruptured right tube from which three embryos, each about 3 centimeters long (8 weeks) had been expelled. *Remarks.* There is one other authentic case of unilateral tubal triplets, that of Krusen, 1902.

Folet, 1895, 1896. A single sac, ovoid and compact, molded about two fœtus with their cords, and the débris of a placenta very degenerated. One a female fœtus at term (46 centimeters standing height); not a lithopedion. The other at about the third month, its head and thorax greatly compressed by the co-twin. Separate cords end in a single placenta. *Remarks.* In spite of the disparity in size these fœtus must be considered twins, according to the history dead for 15 years. The single placenta and gestation sac support this view. The amenorrhœa of the last three years doubtless signifies the normal menopause. A preliminary account of this case was published in 1895.

Grad, 1910. The right tube bore a single chorionic sac which had ruptured and expelled twin fœtus of 14 weeks. *Remarks.* This case appears in the literature simply as a comment appended to Pool's, 1910, society report. Further details have been gained by correspondence with Dr. Grad.

Hardouin, 1914, 1919. A ruptured and bleeding right tube had expelled twin embryos of about 3 centimeters (8 weeks). *Remarks.* The title heading of the appended figure designates the tube as "left"; this is obviously an error. There was one menstrual period after the onset of pregnancy.

Jacquemin, 1903. See Lucas-Championnière, 1903.

Johnson, G. W., 1915. A ruptured and bleeding left tube had expelled two embryos "of about 10 weeks" from a common chorionic cavity. These, with "a single placenta," were found in the abdominal cavity.

Kirchoff, 1894. The swollen and ruptured right tube was coated with coagulum; within its single chorionic sac are 11 millimeter twins (6 weeks) joined by their thoraces (thoracopagi). A common cord bifurcates as it passes to each embryo. *Remarks.* Rupture of the right tube and arrest of the 6 weeks' twins must have occurred a month before the operation. There must have been a single amnion.

Krusen, 1902. The right tube had ruptured and expelled three perfectly formed fœtus from its apparently common chorionic cavity. Fœtus in third month. *Remarks.* The author estimates the age as in the second month. From the illustration it is evident, however, that these triplets were well along in the third month. Hence development must have begun in the month preceding the last scanty flow. One other authentic case of unilateral tubal triplets is recorded by Diamant, 1914.

Launay, P., 1910. See Launay and Sequinot, 1911.

Launay and Sequinot, 1911. Both tubes ruptured; abortion into the abdominal cavity of 13 centimeter (12 centimeter?) twins (standing height) from the

right tube, and a single 13 centimeter fœtus (14 weeks) from the left. The twins are attached by separate cords to a single placenta and hence are monochorionic; the single fœtus has its own placenta. *Remarks.* It appears that the right tube aborted twins on October 21 (as evidenced also by older clots), accompanied by pains in the right side and vomiting; that the left tube aborted a single fœtus at the time of pains in the left side, November 10. It is evident there was one menstrual period after pregnancy had begun. This case was first briefly reported by Launay, 1910. The only other authentic case of triplets bilaterally distributed is that of Baldwin, 1913.

Lucas-Championnière, 1903. The entire right tube enclosed a single, unruptured sac. Hæmorrhage occurred due to breaking of the vascular periphery. Within are twin fœtus of over 8 centimeters (3 months) connected by individual cords to a single placenta. Right ovary cystic and contains an enormous corpus luteum. *Remarks.* This case was also recorded by Jacquemin, 1903, who was an interne at the operation. For some unaccountable reason Costa, 1907, rejects this clear case from his positive list.

McCann, 1906. The left tube contains an ampullary dilatation, surrounded by a clot and containing a chorionic sac, 2½ by 3 centimeters. It is occupied by twin embryos with separate cords but enveloped in a single amnion. *Remarks.* Judging from the illustration the embryos must have been about 20 millimeters long, i.e., between the seventh and eighth week.

Michin, 1905. The left ruptured tube shows two cavities. In one are the remains of an old blood clot; in the other is a large fresh clot containing twin embryos. The left ovary bears a corpus luteum verum. *Remarks.* From the illustration the embryos are apparently about 15 to 20 millimeters long (7 weeks). The old blood clot in a separate cavity of the tube may well be the site of a ruptured gestation sac which had been removed per vaginam two years before.

De Ott, 1891. Tubal twins, 3 months, or perhaps a little more, in age. *Remarks.* No details are furnished; the entire report is in three lines.

Pool, 1910. See Pool and Robbins, 1910.

Pool and Robbins, 1910. In a single chorionic sac within the ruptured and bleeding tube were a clot and twins of 33 millimeters sitting height (9 weeks). The embryos are attached by separate cords to a single placenta and are enclosed by the torn remains of an apparently common amnion. *Remarks.* The limbs of one fœtus moved spontaneously for about a minute after exposure to air. Development of these nine-week embryos began a month before the last protracted flow. This case was reported independently by Pool, 1910.

Pulcher, 1905. At the middle of the left tube lies a tumor the size of a fist. Internally its cavity is divided by a thin, translucent septum into two unequal chambers. Each contains a well-preserved 2 centimeter embryo (7 weeks) whose cords are inserted in the center of the common septum. The two egg cavities are lined with individual amnia. *Remarks.* The common septum must represent the fused walls of two adjoining chorionic sacs—as the insertions of the cords testify. Degeneration of the villi here caused the retarded growth of the fœtus, which, according to the menstrual history, should be 12 to 14 weeks old. This specimen represents a stage in the fusion of separate chorionic vesicles which stands between the cases of Mall, 1915, and Costa, 1907; see Arey, 1922.

Rosenberger, 1906. The left tube was enlarged to the size of a baby's head. It contained two 3 months' fœtus, much flattened.

Rutherford, 1907. A ruptured left tube contains a single chorionic sac from which a placenta and twin embryos had been expelled. Separate amnia. *Remarks.* The illustration shows embryos of about 18 millimeters (7 weeks).

Saenger, 1893. In the interstitial portion of the right tube is a chorionic sac, 4 by 5 centimeters, containing twin embryos of 3 to 4 weeks; individual amnia. At the fimbriated end of the tube is a hazelnut-sized cavity surrounded by blood clots; its wall showed "beautiful decidual cells," but there was no actual embryo. The right ovary contains a corpus luteum verum. *Remarks.* The author considers this a case of triplets (the age is doubtless underestimated). It is, of course, possible, but since there is no embryo in one sac, and but one corpus luteum exists, it must necessarily remain doubtful. Decidual cells alone need not designate the exact location of a tubal pregnancy. Haultain, 1906, has convincingly shown that even the opposite uninvolved tube may contain them from end to end. So also in Salin's, 1895, case decidual cells were found in "both tube and tumors." Another case, apparently of interstitial twins, is that of Robinson, 1892.

Spinelli, 1904. In one tube were twins of 3 months. *Remarks.* The mucosa of the opposite tube showed a decidual reaction.

Strecker, 1892. The left tube, except its extreme ovarian end, comprises a rounded gestation sac, the size of an infant's head; through its ruptured wall placental tissue protrudes. Within are well-developed twin male fœtus, with separate amnia, and separate cords inserted near the middle of the placenta. *Remarks.* (The author's name is not Strocker, as repeatedly miscopied.) The breasts of the woman were greatly enlarged and yielded colostrum. This and the size of the tumor indicate that the fœtus were at least 3 months advanced.

Taylor, G., 1918. The swollen right tube had ruptured into the broad ligament and this secondary sac had in turn burst, as a projecting clot shows. In the blood clot of the broad ligament were found a complete 3.2 centimeter fœtus (8 weeks +) and the head and shoulders of another; the remaining portions were missing but it was surely the co-twin. A single primary gestation sac. *Remarks.* Rupture of the primary sac doubtless caused the first pains

recorded; 10 days later the secondary sac burst. There was one menstrual period after the onset of pregnancy.

Taylor, H. N., 1909. "A ruptured tubal sac with twin fœtus attached." *Remarks.* No further details are furnished except that the patient "believed herself 3 or 4 months along."

Young, 1911. Two separate sacs in the right tube. One sac was ruptured but its embryo not expelled. The second sac, unruptured, contains a twin to the first. *Remarks.* The photograph indicates an age nearer 3½ months. Possibly there was one menstrual period after pregnancy began.

Zunz, 1904. The right tube was torn for several centimeters; from its cavity had been expelled fœtus of 7 and 8 centimeters (11 weeks ±). Apparently a single cord. *Remarks.* A regular mensis, and bleeding a month later, came after the development of these 11 weeks' fœtus had begun.

2. PROBABLE CASES

Ferroni, 1903. The left tube presents two enlargements, separated by a small stretch of undistended normal tube. The dilatation nearer the uterus is the size of an egg; the other, the size of a walnut. These sacs are full of blood, fibrin, and detritus and show chorionic villi. Actual embryos not present. Left ovary has a corpus luteum undergoing regression. *Remarks.* The identity of structure of the two sacs, although of different size, and the history make it probable that this was a twin gestation of about 3 months' duration.

Mall, 1915. An unruptured tube bears a swelling the size of a walnut. Internally it contains two equal sacs, at almost the same transverse level, flattened and thinned on their surfaces of mutual contact. This common membranous septum is composed of the approximated chorionic walls, more or less separated by villi. Amnia and embryos have disintegrated totally. All villi show incipient hydatidiform degeneration. A small corpus luteum in the right ovary. *Remarks.* This case (Vest specimen, No. 825) is also described by Meyer, 1920. There is little doubt that these were double-ovum twins. The thin oppressed chorionic walls represent a preliminary stage in the fusion of double ova into a single vesicle (Arey, 1922). Pulcher, 1905, and Costa, 1907, have described specimens which illustrate later stages.

Meyer, 1920. See Mall, 1915.

Minchinard, 1896. A ruptured left tube and two unequal fœtus. The larger is an expelled normal female fœtus, 33 centimeters long (8 months ±). The other was found among clots in the sac; it is flattened and shrunken, 6.5 centimeters long. Each had an individual cord and placenta. *Remarks.* The author believes these fœtus are twins. The gestation sac is referred to as if it were single, and the photograph of the torn specimen rather supports this; on the other hand, there were separate placentæ. On the basis of the clinical history and the anatomical description, this case must be classified as probable or presumptive.

Robinson, 1892. Two embryos were passed on successive days. Curettement produced small pieces of placenta from the region of the right tubal ostium. The embryos were more than 13 centimeters long (14 weeks), but they had been compressed and elongated. Heads were mangled and sexes not distinguishable. *Remarks.* The author states: "It was undoubtedly an interstitial pregnancy on the right side. The shape of the uterine cavity, as disclosed by the several examinations, negatives the probability . . . of uterus bicornis." Lack of direct evidence eliminates this from the positive cases of tubal twins. Undoubted interstitial twins have been recorded by Saenger, 1893.

Rupin, 1860. The gestation sac, 20 centimeters in diameter, comprises the left tube and apparently its broad ligament. Within is a large placenta belonging to a 6 months' fœtus removed by colpotomy. Close to the placenta were found all the bones of a 4 months' fœtus. Left ovary atropic; the right ovary bears a corpus luteum. *Remarks.* Does the occupancy of a single sac and the existence of a single corpus luteum in the opposite ovary signify twins, one of which died at the fourth month and subsequently macerated? The additional evidence furnished by an attack of violent pain at the fourth month makes this appear probable.

Saniter, 1905. The right tube shows two enlargements. The larger is at the ovarian end, the size of an egg, and has a torn wall; it contains a fœtus of 4.0 centimeters. The smaller dilatation is 1 to 2 centimeters in diameter; it is near the uterus and about 2 centimeters distant from the larger sac; in its wall is a small punctate rupture, through which chorionic villi protrude. This smaller sac has macroscopic villi, but no embryo was found. The right ovary bears a large corpus luteum and a small corpus albicans; the left ovary was not inspected. *Remarks.* The history indicates that on April 15 the smaller dilatation ruptured and its embryo underwent expulsion or resorption; the other ovum continued development until its rupture on May 5. The single corpus luteum, however, does not favor this interpretation. There may have been one menstrual period after pregnancy had begun.

Schauta, 1905. In the right tube are two gestation sacs: One, 4 by 5 centimeters, contains a macerated fœtus 6 centimeters long (12 weeks); the other is 1½ by 2 centimeters but contains no fœtus. Both sacs are highly hæmorrhagic. *Remarks.* It is probable that this is a twin pregnancy in which one embryo died during the first two proximal attacks and was subsequently resorbed, whereas the second embryo was unaffected until the severe internal hæmorrhage a month later.

Treub-Cullen. In a personal communication to Pool and Robbins, 1910, Dr. T. S. Cullen states that while in Amsterdam Prof Treub "gave me a picture showing five embryos apparently between three and four months. They came from a tubal pregnancy.

This case did not come under Dr. Treub's personal observation, but occurred in the service of a colleague in one of the other Dutch cities." McCalla, 1909, reports Dr. Cullen as stating in a personal letter that all five embryos were in one tube. McCalla further cites Dr. Cullen as having seen several cases of twin tubal pregnancy and bilateral pregnancy; on the contrary, Pool and Robbins quote him as follows: "Personally I have not had any cases of twin tubal gestation. *Remarks.* Quintuplets in one tube are unique. Owing to the lack of direct proof of the authenticity of this remarkable case, and the paucity of details furnished, it can scarcely be admitted to the positive list.

3. POSSIBLE CASES

Fenger, 1891. The left tube had ruptured and expelled a single embryo still connected by its cord to a placenta within. The embryo is said to be in its second month. Nearer the uterus was a second ovum, degenerated and cystic, measuring 1 by 1½ inches. *Remarks.* This is at best a doubtful case of twins.

Handley: Cameron, 1906, refers to Handley who had examined a case of unilateral ectopic twins of unequal size. As no further details are furnished this must rank as a doubtful case.

Johnson, F. W., 1894. The right tube is enlarged to a dark red egg-shaped mass, 3 by 4 centimeters; its interior is a blood clot containing thread-like masses, evidently chorionic villi. The ovarian end of the left tube is dilated into a rounded shell, 1.5 by 2.5 centimeters; a protruding clot is continuous with a mass filling its interior, which contains structures resembling very poorly formed villi. In the wall of the left tube, near its uterine end, is a small clot containing numerous small branching villi. In the right ovary is a "yellow opaque body"; in the left ovary a corpus luteum verum, 1 centimeter in diameter. *Remarks.* The anatomical report (by Dr. Whitney) apparently reverses the designation of the tubes as right and left. The regressive changes are so nearly complete that the true condition (twins, triplets, or successive pregnancies) remains in doubt.

Salin, 1895. The enlarged right tube bears two dilatations: one, near its ovarian end, is the size of an egg; the other, close to the ovary, is the size of an almond. The two sacs have plain walls and are filled with normal blood. Hasty examination showed the presence of decidual tissue in "both tube and tumors." *Remarks.* The author considers this a twin pregnancy; although plausible in view of the clinical history, it must remain a doubtful case. (See remarks on decidual cells under Saenger's case, 1[illegible].

SUMMARY

The essential anatomical facts from all existing cases of tubal twin pregnancy have been concisely summarized and made accessible.

This enumeration shows that 40 cases (including two new specimens) describe positive or authentic cases. Eight are probable or presumptive. Four are possible but doubtful.

Two new specimens of single-ovum tubal twins are described, thereby increasing the authentic total to forty. One pair has a common yolk-sac, thus for the first time furnishing direct proof of the origin of human homologous twins from a single egg. The other twin pair may have resulted from an unequal division through which one individual received essentially the entire yolk-sac. Hence the yolk-sac appears as a vestige unessential physiologically to growth or differentiation.

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DEPARTMENT OF TECHNIQUE

A NEW TECHNIQUE FOR THE CLOSURE OF THE ABDOMEN

By RODOLFO E. PASMAN, M.D., F.A.C.S., Buenos Aires, Argentine
Surgeon to the Dawson Hospital

ALL surgeons have had trouble in some cases of acute abdomen in closing the peritoneal layer. It is only by giving the patient such large doses of ether or chloroform as to produce complete muscular relaxation, that the operator is able easily to approximate the different layers of the abdominal wall. To overcome the difficulties encountered in closing the wound, I have for some years used the technique described.

First, I place sterile gauze over the protruding omentum and intestine to protect it from contamination (Fig. 1). Then I place three or four isolated strong catgut sutures through all the layers of the abdomen except the skin, later starting the suture of the peritoneum alone with a continuous mattress suture which is left loose. I tie the three or four isolated stitches one after the other (Fig. 2) and slowly remove the protecting gauze. By making traction slowly and firmly at the end of the mattress suture (Fig. 2), I bring into perfect approximation the edges of the peritoneal layer. The rest of the wound which is no longer under such tension, is closed in the same manner, the closure of the serosa being finally easily accomplished.

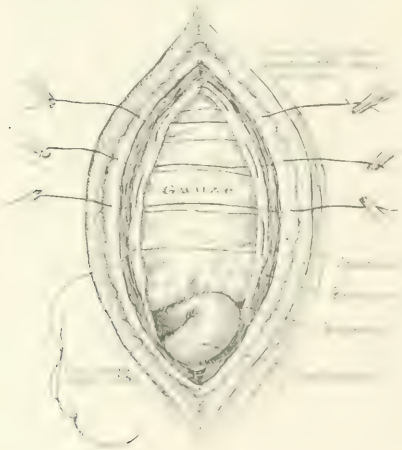


Fig. 1.

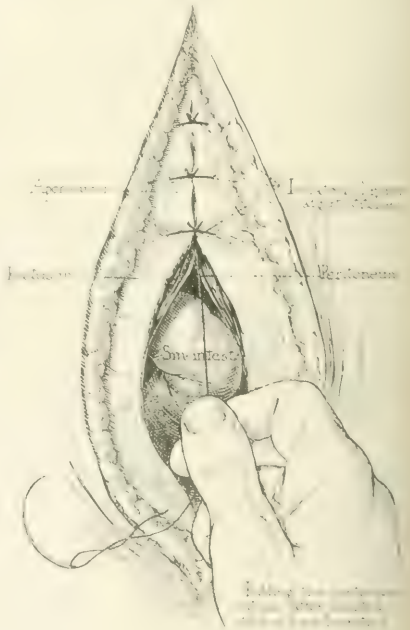


Fig. 2.

IDENTIFICATION OF THE COMMON BILE DUCT IN THE PRESENCE OF AN ANOMALOUS CONDITION OF THE BILIARY PASSAGES

By JOHN HOMANS, M.D., F.A.C.S., Boston
From the Surgical Clinic of the Peter Bent Brigham Hospital

An exceedingly short cystic duct is one of the infrequent but important anomalies of the bile passages. The common duct is then so closely attached to the gall bladder as to appear to emerge from its wall. Much the same effect obtains when long-standing inflammation renders the two particularly adherent, but the congenital anomaly is the more deceptive. For in performing cholecystectomy under these circumstances, when the peritoneum and retroperitoneal fat have been divided from the ampulla of the gall bladder across the edge of the gastrohepatic omentum and traction is being made upon the ampulla, the common duct is disclosed passing downward and inward from the gall bladder in the position and direction usually taken by the cystic duct. Unless the operator is particularly vigilant he is likely to clamp and divide this duct for its anatomical relations, *more especially when the dissection is easy and the exposure good*, are little likely to awaken his suspicions.

A very constant and satisfactory means of identifying the common bile duct (once the peritoneum and fat are dissected from it) is the presence of a blood vessel which passes longitudinally along its anterior surface. There may be visible a small tortuous artery but what perhaps catches the eye more readily is the vein or group of veins which accompanies it. Such vessels are never seen upon the wall of the cystic duct, nor does the cystic artery offer a possibility of confusion since its course to the gall bladder is well away from the duct. Theoretically the operator should expect to see a small, beaded or spirally marked tube when he is looking for the cystic duct, but long-standing dilation and thickening may obliterate these markings and render the tube as cylindrical and as large as the common duct. The presence of a visible blood vessel in the wall of a biliary passage should suggest at once that it is the principal biliary channel to the duodenum and not the cystic branch.

The accompanying diagrammatic sketches show:

a. The appearance and relations of the gall bladder, the cystic and the common ducts when the peritoneum over them has been widely split and retracted. The presence of the characteristic vessel in the wall of the common duct is disclosed. It will be noted that the cystic artery does not accompany the cystic duct.

b. The appearance and relation of the common duct to the gall bladder when the former is angulated and drawn into the position of the normal cystic duct by traction upon the ampulla. The sketch is based upon two almost identical operative cases. The peritoneum over the common duct has been split as in Figure *a*.

c. The fully dissected region of the cystic duct itself. The duct is shown blocked by a small stone. Such a condition was present in one of the two cases. In the other, the cystic duct was even shorter and more difficult to identify.

The writer believes that anomalies such as this, as well as others of the ducts and blood vessels which Eisendrath[1] has recently so well described and figured, should warn surgeons to perform cholecystectomy only by the sense of sight through dissections as open as circumstances permit. He is convinced that any difficulty in identifying the cystic duct should lead the operator to enucleate the gall bladder from the fundus inward and even to leave a bit of gall-bladder wall behind rather than to run a risk of injury to the common duct.

[1] Eisendrath, D. N. Operative injury of the common and hepatic bile ducts. Surg., Gynec. & Obst., 1912, xxvi, 1.

OVERHEAD ELEVATOR

By PAUL N. JEPSON, M.D., Rochester, Minnesota
Fellow in Orthopædic Surgery, The Mayo Foundation

THE handling of patients who must be kept quiet and on their backs or faces for any length of time necessitates the employment of some special apparatus by means of which their care may be facilitated. Such an apparatus has been devised in the Section on Orthopædic Surgery of the Mayo Clinic, with the object of immobilizing the patient, increasing his comfort, and lessening the work of the nurse.

The apparatus consists, first, of a modified Balkan overhead frame; second, a Bradford frame on which the patient is placed; and, third, an elevating appliance which is attached to the bed.

The Balkan frame was modified so as to facilitate its transportation from one room to another, and also to make it adjustable to any bed. The top can be lifted off (Fig. 1*b*) and the entire frame changed from one room to another in a few minutes.

The Bradford frames are made from ¾ inch gas pipe and the bed portion is made of canvas and laced to the pipe frame with rawhide thongs (Fig. 1*d*). An opening is left at the buttocks.

The elevating appliance is made to attach to the posts at the foot of the bed. It consists of a shaft, a crank, a Ford timing gear, and two enema can-holders used as hangers for the shaft. To one of the hangers is attached a simple "dog" (Fig. 1*e*) by means of which the elevation of the frame can be controlled. The crank is left loose in the shaft so that the handle part may be turned in, out of the way (Fig. 1*e*). Four steel eyes are riveted into the shaft through which the ropes are tied. Ordinary window-sash cord may be used.

By means of a ¼ inch steel hook, a 2 inch double awning pulley is attached to each corner of the Bradford frame. These pulleys have one eye. To each corner of the Balkan frame is attached a 2 inch double pulley with two eyes. The ropes are then threaded block-and-tackle fashion and tied to the crank shaft at the foot of the bed. Two additional double pulleys are bolted to the cross bar at the foot of the frame to guide the ropes to the crank shaft.

When the patient uses the bed pan, the frame is elevated 6 or 8 inches by turning the crank;

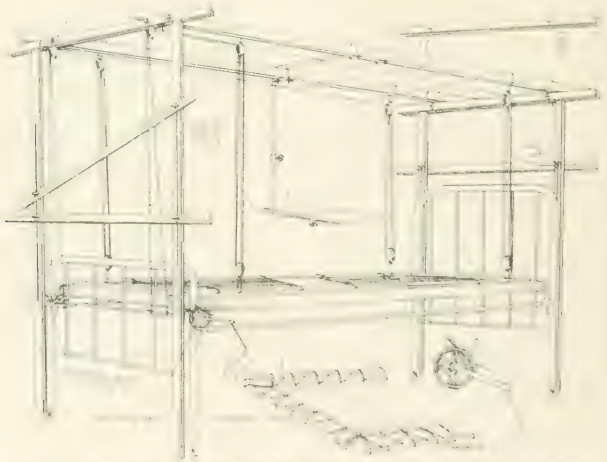


Fig. 1. *a*, Balkan frame; *b*, method of knocking down frame; *c*, table; *d*, Bradford frame; *e*, gear with "dog" and adjustable crank.

this elevation is held by means of the "dog" which locks the Ford timing gear and keeps the patient from slipping. The pan may be placed beneath the frame and the patient left alone. If the patient is incontinent, the frame may be elevated 2 or 3 inches and the bed clothing kept perfectly dry.

These frames have been used satisfactorily for patients on whom Albee bone graft operations and Hibbs operations for tuberculosis of the spine have been performed; also for patients with fractures of the pelvis, and fractures of the femur put up in double spica casts of the hip; for patients who have had laminectomies, for patients with transverse myelitis with incontinence, and for old debilitated patients.

The cost of the entire structure, including bolts, pulleys, and so forth, is less than ten dollars.

AN INSTRUMENT TO FACILITATE THE THREADING OF SURGICAL NEEDLES

By FREDERICK S. RICHARDSON, B.S., M.B. Minneapolis, Minnesota
From the Department of Surgery, University of Minnesota Medical School

SURGEONS working with fine needles such as are used in eye, nerve, blood-vessel, and intestinal operations are often delayed because of the time required for threading fine-eyed needles. Self-threading needles have been offered as a solution of this problem, and, indeed, are used by many surgeons who specialize in delicate work. However, after a few sterilizations this type of needle becomes rusty and cuts the ligature.

To avoid delay attending the threading of needles, the instrument described has been devised and has proven satisfactory with the finest needles. A search of the literature has not revealed a similar device.

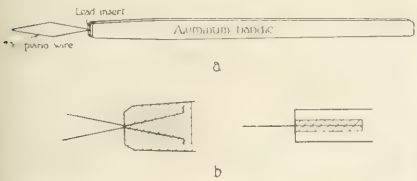


Fig. 1

Fig. 1 Diagram of completed instrument.

Fig. 3

Fig. 3. Steps in procedure.

In brief this is a loop of very fine silver-plated piano wire of .003″ to .009″ in diameter bent into an elongated diamond shape, three-quarters or one inch in length, and placed in a suitable handle of aluminum 4 inches in length (Fig. 1, *a*).

The ends of the wire that fasten into the handle are bent at right angles at their ends and are placed between two thin sheets of lead. The lead is then pressed and the wire imbedded in the same. The lead and wire are inserted into a narrow slot in the aluminum handle (Fig. 1, *b*).

The handle is firmly pressed down on the lead and wire. This method insures holding the wire firmly in the handle without solder, which would tend to take the temper out of the piano wire.

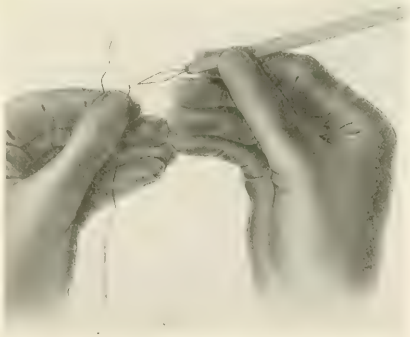


Fig. 2. Drawing showing position of hands.

To protect the wire when not in use, a pencil cap may be slipped over the end. The needle threader should be chemically sterilized, as by carbolic and alcohol, rather than by boiling, so as to insure long life to the temper. However, the instrument will stand many subjections to heat, one of them having been sterilized by boiling repeatedly without evident impairment.

TECHNIQUE

The ligature is picked up between the thumb and forefinger of the left hand so that about 1 inch of the free end protrudes above the fingers. The needle is then grasped between the same thumb and finger as the thread, and the threader is grasped between the thumb and forefinger of the right hand. The lower fingers are in contact, steadying the manipulation (Fig. 2). The point of the diamond-shaped loop is thrust through the eye of the needle (Fig. 3, *a*), and after the loop has expanded on the other side of the eye, the needle is dropped by the left hand and the ligature is passed through the loop (Fig. 3, *b*), the needle regrasped by the left hand and the loop redrawn, carrying the ligature through the eye of the needle (Fig. 3, *c*).

The use of this device at the University Hospital and in the laboratory of surgical research has proven to be a time and labor saver.

A SIMPLIFIED "TOWEL CLIP"

By L. M. STEARNS, M.D., Kearney, Nebraska

NEW methods of technique in operative procedure are always of interest to the surgeon, and any means of simplifying the work always appeals to one.

It has always appeared to me that since with the ordinary towel clip, it is necessary to use from four to six or more of them, there are too many instruments about the field of operation. Not only that, but many hesitate to apply the clips in such a way as to transfix the skin. If the skin is not transfixed the towels frequently slide over the wound margin and thus are apt to carry bacteria from the skin over into the depths of the wound.

The "clips" I have designed are used in pairs, one applied to each end of the incision. The clip consists of three armed hooks, one stationary and two of which slide in a square bar and are adjustable, holding the clip in position automatically. The central hook has a small nob fused on the outer curvature to prevent the towels from riding over it, as shown in cut.

The incision is made down to the deep fascia with one stroke of the knife. The knife may then be re-carbolized. The superficial fascia is freed from the deep fascia for about ¼ inch on each side: this provides better exposure. Then a towel

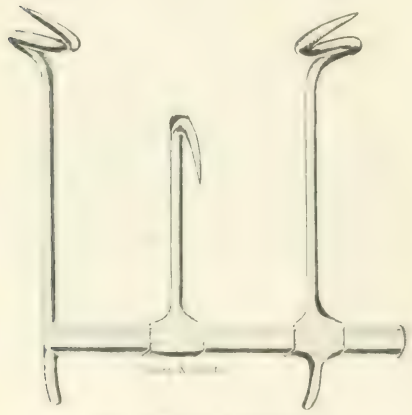


Fig. 1. Drawing of instrument

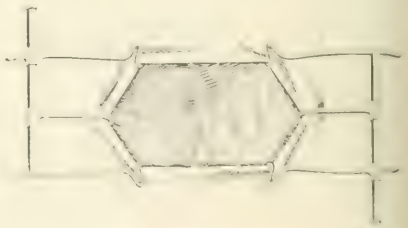


Fig. 2. Instrument applied

is placed on each side of the incision, the borders folded over the skin about one-quarter inch and overlapping at the ends of the incision.

The central hook is placed through the towels and immediately under the skin at the end of the incision. The lateral hooks are tilted down and engaged through the towels on either side of the wound, penetrating the areolar tissue and the arms spread the desired distance. Additional towels may be used to cover the cross bars at each end.

ADVANTAGES

The advantages may be summed up as follows:

1. They lay flat and are out of the way.
2. They lessen the number of instruments about the field of operation.
3. They do not interfere with the use of larger retractors in the depths of the wound.
4. They positively prevent the towels from slipping when properly adjusted.
5. They do away with the necessity of suturing towels to the peritoneum or other membrane and the unnecessary trauma caused thereby.
6. They do not perforate the skin, and lessen the likelihood of carrying bacteria into the wound.
7. They "stay put" until the operation is complete and are easily removed after the fascia is sutured.

A "TWO-FORCEPS MANŒUVRE" FOR PERSISTENT OCCIPITOPOSTERIOR PRESENTATION

By SAUL SEIDES, M.D., New York

Associate Obstetrician, Jewish Maternity Hospital; Assistant Gynecologist and Obstetrician, Israel-Zion Hospital of Brooklyn; Assistant Gynecologist, Out-Patient Department, Beth Israel Hospital

THE management of persistent occipitoposterior presentation has been a constant source of anxiety to the obstetrician. Unsatisfactory results in this class of obstetric cases may be traced largely to two causes:

1. To the fact that this complication is frequently overlooked and consequently the patient is not watched with sufficient care and is not treated in accordance with the requirements of her case; and

2. To the fact that the methods of delivery of such cases in vogue at the present time are complex, difficult, and uncertain.

As soon as the malposition is recognized, proper care should be exercised in conducting the first stage of labor to safeguard the interests of the patient. The number of vaginal examinations must be limited to a minimum. The membranes should be kept intact as long as possible. The patient should be protected against exhaustion by rest and suitable doses of morphine. (The latter also helps to soften the cervix and aids dilatation.) The policy of intelligent expectancy must be strictly adhered to. The natural forces must be permitted to work to correct the malposition and at the same time watch must be kept for the signs indicating maternal exhaustion and fœtal danger.

In dealing with a persistent occipitoposterior position—that is to say, when the posterior position persists beyond the point of safety for mother or child, and the labor must be terminated by resorting to artificial means—we are confronted by the problem of choosing the method of delivery suitable for the particular case at hand. We ordinarily think of one of the following methods, every one of which has its warm and distinguished advocates:

a. Manual rotation of the head followed by forceps extraction;

b. Forceps rotation and traction synchronously carried out;

c. Forceps extraction with the occiput remaining posteriorly;

d. Version; and

e. Forceps rotation followed by reapplication and extraction (double application of forceps).

Manual rotation requires considerable intra-

pelvic and intra-uterine manipulation and is not always successful even in the hands of the most skillful obstetrician. De Lee advocates grasping the scalp with a tenaculum forceps after manual rotation, in order to prevent the head from slipping back to its former position.

The method of forceps delivery by rotation and traction synchronously carried out is the favorite method and most commonly employed in spite of the fact that this method, next to the one of extraction with the occiput in the posterior position, requires excessive force. It is the most difficult to perform and is attended by serious injuries to mother and babe.

Version as a method of procedure in the occipitoposterior cases does not readily appeal to one especially where the uterus is exhausted and the amniotic fluid has drained off a long time before.

The manœuvre of double application of forceps, originated by Sconzoni, is based on the rational principle that before traction is made on the head, the occiput must be brought under the symphysis by correcting the malposition. For it is only when this position is corrected that brute force will be avoided. Sconzoni's manœuvre is carried out as follows:

The forceps are applied so that the points of the blades are directed toward the babe's forehead, and the head is rotated from the oblique to the transverse diameter of the pelvis. The forceps are then removed and reapplied with the points of the blades directed toward the occiput, and the rotation continued until the occiput is brought under the symphysis. Then traction is used and the delivery completed.

But Sconzoni could employ his method only when the head was on the perineum. When the head is at a higher level, Sconzoni's manœuvre can be carried out only after the head has been pulled down to the pelvic floor—a procedure which is both difficult and dangerous.

A few years ago Bill, of Cleveland, described a modification of Sconzoni's manœuvre. He makes a cephalic application in whatever plane of the pelvis the head happens to lie, and brings the occiput directly under the symphysis with one gentle sweep of the handles of the forceps. Bill's manœuvre, while easily carried out, has two objectionable features: (1) the head is sometimes turned to a degree that involves a dangerous twisting of the neck of the fœtus; (2) when the blades are removed to be reapplied, the head tends to turn back to its former position and the rotation has to be repeated.

While endeavoring to render the forceps operation in cases of persistent occiput posterior position both safe and successful, I evolved a new manœuvre which for several years I have employed with the most gratifying results.

The steps of the operation are as follows: The exact location of the head in the pelvis is ascertained and the forceps are introduced with the points of the blades directed toward the face of the fœtus, and are so adjusted that they grasp the head in a true cephalic manner and the blades lie parallel with the sagittal suture (Fig. 1).

I find that the introduction of the anterior blade first makes the adjustment of the forceps easier. The forceps lock perfectly if the application is a correct one.

Before rotation is begun, the head, which in the occipitoposterior positions is somewhat extended, is first flexed by shifting the handles of the forceps in a straight line to a point diametrically opposite the one at which they were originally (Fig. 2). Now the head is rotated by gently moving the handles first downward and outward (Fig. 3), then downward and inward (Fig. 4), thus describing an arc of a circle. At the same time, using abdominal manipulation, the nurse or assistant turns the body of the fœtus so as to bring its back forward. The movement of the forceps is continued until the blades become inverted and the small fontanelle is felt under the symphysis (Fig. 5). Now the blade on the left side of the pelvis is removed, and the left blade of another pair of forceps, which I have at hand, is introduced (Fig. 6); then the inverted blade on the right side of the pelvis is removed and the right blade of the other pair of forceps is introduced (Fig. 7). The second forceps is now locked and the

delivery is completed by a simple extraction of the head with the occiput in the anterior position.

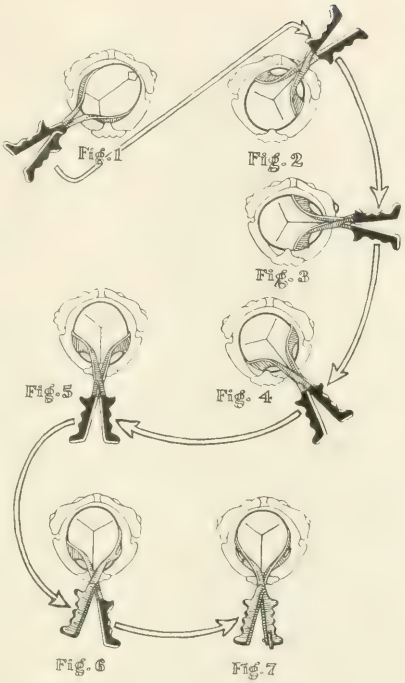
The simultaneous rotation of the body and head obviates the possibility of excessive tortion of the neck. The employment of the two pairs of forceps, with the alternate removal and application of their respective blades, counteracts the tendency of the corrected head to rotate back into its former position after the removal of the first forceps. The blade remaining in the pelvis during the application, acts as a splint supporting the head in its new corrected position. Since two sets of blades are required for this operation I have named it "two-forceps manœuvre."

This manœuvre is carried out with the utmost ease and with the least consumption of time. No force whatsoever is required. The safety of the manœuvre is attested by an analysis of the cases reported below.

I have employed the "two-forceps manœuvre" in 60 consecutive cases of persistent occipitoposterior position. All of these cases were carefully watched and every opportunity afforded for spontaneous rotation. Artificial delivery was resorted to only when it became clearly evident that further delay in terminating labor would jeopardize the well-being of mother or child.

The indications for interference as regards the mother's condition were: secondary inertia appearing after a period of strong, frequent, and agonizing pains; marked increase in pulse rate; and a rise of temperature. The points watched for as regards the fœtus' condition were: excessively rapid or excessively slow and irregular fœtal heart sounds; and the appearance of meconium. In the presence of the above danger signs, artificial delivery was resorted to irrespective of whether the head was high up or low down in the pelvis and whether or not the cervix was completely dilated. Among the 60 cases there were 7 in which the manœuvre had to be carried out with the cervix incompletely dilated, and 5 in which the head was at the inlet.

In this series of 60 cases, there were primiparæ 39, multiparæ 21; right occipitoposterior was encountered 33 times, left occipitoposterior 23 times, occipitosacral 4 times. The average duration of arrested progress (or period of watchful expectancy) was 4 hours. Morphine was used in the first stage in 28 cases. In 24 cases pituitrin was employed one or more times in the expectation that the increased strength of the uterine contraction might effect a spontaneous rotation of the head. I wish to remark here that the employment of pituitrin in cases of persistent occipitoposterior is attended with a definite risk, for, in the presence of obstruction to the progress of the head, the use of pituitrin increases the likelihood of asphyxia due to cerebral compression and interference with placental circulation. But whenever employed I had the forceps ready and the



Figs. 1 to 7 illustrate steps in "two-forceps manœuvre."

TABLE OF SIXTY CASES OF PERSISTENT OCCIPITOPOSTERIOR POSITION

Case No.	Year	Age	Para	Position	Duration of labor (hours)	Rotation of occiput to pubes before delivery	Version (forceps)	Cervical dilatation at time of delivery	Length of head (cm.)	Medication during labor; anesthetic, sedative	Maternal causes	Fetal malformations	Fetal mortality	Maternal morbidity	Fetal morbidity	Weight of baby	Condition of bladder	Condition on discharge	Remarks
[illegible]	[illegible]	[illegible]	1	R O P	[illegible]	[illegible]	[illegible]	Full	Medium	Morph. [illegible] Pit [illegible]	Superficial tear	None		None	None	7 lb. 10 oz.	None	Good	
[illegible]	[illegible]	[illegible]	[illegible]	R O P	65*	[illegible]	[illegible]	Incomplete	Medium	Morph. [illegible] Pit [illegible]	Lacer. from os cervix	None		None	None	8 lb. 9 oz.	None	Good. Cervix healed	Irregular. Very [illegible] fetal heart [illegible] Mother's Temp. [illegible] Pulse [illegible] Baby resuscitated. 2 sutures for cervical tear
[illegible]	[illegible]	[illegible]	[illegible]	R O P	[illegible]	[illegible]	[illegible]	Full	Medium	Morph. [illegible]	Medium epistotomy	None	Still born	Temp. [illegible] for 1 day			Cath. [illegible] days	Cerv. lac.	No fetal heart 1 hour before delivery. M. [illegible] and cast [illegible] urine
[illegible]	[illegible]	[illegible]	1	R O P	[illegible]	[illegible]	[illegible]	Full	Medium	None	Med. epis.	None		None	None	6 lb. 14 oz.	Cath. [illegible]	Good	
[illegible]	[illegible]	[illegible]	1	R O P	80	[illegible]	1	Full	Medium	None	Lat. epis.	None		None	None	8 lb. 10 oz.	None	Lat. cerv. tear	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Full	Medium	None		None		None	None	10 lb. 10 oz.	None	Good	
[illegible]	[illegible]	[illegible]	[illegible]	R O P	[illegible]	[illegible]	[illegible]	Full	Medium	Pit. [illegible]	Med. epis.	None		None	None	8 lb. 1 oz.	None	Good	
[illegible]	[illegible]	[illegible]	[illegible]	O.A.	[illegible]	[illegible]	[illegible]	Full	Medium	None	None		Still born	None	None		None	Good	Fetal heart not heard on admission. Advanced cardiac
[illegible]	[illegible]	[illegible]	[illegible]	R O P	[illegible]	[illegible]	[illegible]	Incomplete	Medium	Pit. [illegible]	None	None		None	None	11 lb. 2 oz.	None	Good	
[illegible]	[illegible]	[illegible]	1	L O P	[illegible]	[illegible]	[illegible]	Full	Medium	Morph. [illegible]	Lat. epis.	None		None	None	8 lb.	Cath. for [illegible] hrs.	Good	
[illegible]	[illegible]	[illegible]	1	R O P	[illegible]	10	[illegible]	Full	Medium	Morph. [illegible] Pit [illegible]	Med. epis.	None		None	None	6 lb. 3 oz.	None	Good	
[illegible]	[illegible]	[illegible]	[illegible]	R O P	[illegible]	[illegible]	[illegible]	Full	Low	Morph. [illegible]	gel. deg. tear	None		None	None	6 lb. 13 oz.	None	Good	Contracted pelvis
[illegible]	[illegible]	[illegible]	[illegible]	R O P	[illegible]	[illegible]	[illegible]	Incomplete	Medium	Morph. [illegible] Pit [illegible]	tot. lac.	None		None	None	6 lb. 14 oz.	None	Good	
[illegible]	[illegible]	[illegible]	[illegible]	L O P	[illegible]	[illegible]	[illegible]	Full	Medium	None	None	None		None	None	7 lb. 13 oz.	None	Lat. cervix	
[illegible]	[illegible]	[illegible]	[illegible]	R O P	[illegible]	[illegible]	[illegible]	Full	Low	[illegible]	None		Still born	None		9 lb.	None	Good	Skin macerated
[illegible]	[illegible]	[illegible]	[illegible]	R O P	80	[illegible]	[illegible]	Full	Low	None	None	None		None	None	8 lb. 4 oz.	None	Good	
[illegible]	[illegible]	[illegible]	[illegible]	L O P	[illegible]	[illegible]	[illegible]	Full	Low	[illegible]	None	Abn. [illegible] of face		None	None	11 lb. 6 oz.	None	Lacerated cervix	
[illegible]	[illegible]	[illegible]	[illegible]	R O P	[illegible]	[illegible]	[illegible]	Full	Low	Pit. [illegible]	None	None		None	None	9 lb. 9 oz.	None	Good	
[illegible]	[illegible]	[illegible]	[illegible]	R O P	[illegible]	[illegible]	[illegible]	Full	Low	None	None	None		None	None	8 lb. 7 oz.	None	Good	
[illegible]	[illegible]	[illegible]	III	R O P	[illegible]	[illegible]	[illegible]	Full	Medium	Pit. [illegible]	None	None		None	None	10 lb. 8 oz.	None	Good	
[illegible]	[illegible]	[illegible]	1	R O P	[illegible]	[illegible]	[illegible]	Full	Medium	Morph. [illegible]	Med. epis.	None		None	None	8 lb. 12 oz.	None	Good	
[illegible]	[illegible]	[illegible]	III	L O P	[illegible]	[illegible]	[illegible]	Full	Medium	None	None	None		None	None	7 lb. 13 oz.	None	Good	
[illegible]	[illegible]	[illegible]	1	L O P	[illegible]	[illegible]	[illegible]	Full	Low	None	Lac. [illegible] tion	Abn. [illegible] on right cheek		None	None	8 lb. 11 oz.	None	Good	
[illegible]	[illegible]	[illegible]	1	R O P	[illegible]	[illegible]	[illegible]	Full	Low	Morph. [illegible]	Med. epis.	None		None	None	7 lb. 14 oz.	None	Good	
[illegible]	[illegible]	[illegible]	1	L O P	[illegible]	[illegible]	[illegible]	Full	Medium	Morph. [illegible]	Med. epis.	None		None	None	8 lb. 9 oz.	None	Good	
[illegible]	[illegible]	[illegible]	1	R O P	[illegible]	[illegible]	[illegible]	Incomplete	Medium	Morph. [illegible]	and lac.	None		None	None	9 lb. 2 oz.	None	Good	
[illegible]	[illegible]	[illegible]	1	L O P	[illegible]	[illegible]	[illegible]	Full	Low	Morph. [illegible] Pit. [illegible]	Med. epis.	None		None	None	6 lb. 8 oz.	None	Good	

1936	M G	21	I	L O P	Over 72	Over 8	4	Incomplete	Medium	Morph 1·2 Choral Sod Brom.	None	Abrasions on both cheeks	Still born	None	None	8 lb. 5 oz.	None	Small left lat lac.	Meconium passing 4 hrs. before delivery. Fœtal heart sound not heard 2 hrs. before delivery
1936	R A	21	I	L O P	21	1½	Over 5	Full	Medium	None	Med episs.	None		None	None	7 lb 11 oz.	Cath. (1)	Good	
1936	R H	31	I	L O P	28	12	5	Full	Low	Morph 1·0 Pit. 1·2	Lat episs		Still born	None	None	11 lb 8 oz.	None	Good	Fœtal heart sound not heard 12 hrs. before delivery
1937	R A	27	III	R O P	11	7	1	Full	Low	None	None	None		None	None	5 lb.	None	Good	
1937	D B	24	I	L O P	5	16	2	Full	Medium	Morph 1·0	2nd deg laceration	None		None	None	8 lb.	Cath (111)	Good	
1937	D D	18	I	L O P	37	14 Fully dilated on admission	Over 5	Full	Low	None	Med. episs	None		None	None	6 lb 12 oz	Cath. (4)	Good	
1938	P A	23	I	L O P	23	9	9	Full	High	Morph. 1·0 Pit 1·0	Lat episs	Abrasion on face		Temp 101° for 8 hr	Temp 101 - 6° for 2 da	8 lb 2 07	Cath. (1)	Perineum lac	Mother's Temp. before del. 100° Pulse 120. Perineal wound infected
1938	L M	24	II	R O P	15		1	Full	Low	None	None	None		None	None	8 lb 10 oz.	None	Good	
1937	D M	26	I	R O P.	36	24+	6	Full	High	Morph 1·0	Med. episs.	None		None	None	6 lb 11 oz.	None	Good	
1938	R B	25	I	L O P	17	17	2	Full	Low	None	Episs	None		None	None	7 lb. 14 oz	None	Good	
1938	R H	34	IV	R O P.	7½	12	2	Full	Medium	None	None	None		None	None	5 lb 12 oz	None	Good	
1938	B S	28	I	R O P.	10	2	1½	Full	Medium	None	1st deg laceration	None		None	None	6 lb 8 oz	None	Good	
1938	D E	33	III	R O P.	11	2½	2	Full	Low	None	1st deg laceration	None		None	None	7 lb 4 oz.	None		
1938	L Z	24	I	R O P	8	½	1	Full	Low	None	Med episs	None		None	None	6 lb. 6 oz	None	Good	
1938	S R	34	I	L O P	30	2½	2	Full	Medium	Morph 1·0	Med episs	None		None	None	7 lb 11 oz	None	Good	
1938	L G	21	I	R O P	18	8	1	Full	Medium	Pit 1·0	Med episs	None		None	None	10 lb 6 oz	None	Good	
1938	I M	30	I	L O P	15	8½	1½	Full	Medium	Morph 1·0 Pit 1·0	Med episs	None		None	None	6 lb 6 oz	None	Good	
1937	B G	31	II	O.S.	39	1?	?	Incomplete	High		None	None		None	None	11 lb 3 oz	None	Good	Head rotated. Waited for complete dilatation extracted
1937	I N	21	I	L O P	38	Over 18	7	Full	Medium	Morph. 1·0 Pit 1·0	Med. episs	None		None	None	7 lb 0 oz.	Cath (1)	Good	
1938	L L	28	II	R O P	8	8	?	Full	Medium	None	None	None		None	None	7 lb 12 oz.	None	Stellate tear of cervix	
1938	I M	28	III	R O P.	24	Over 5	2½	Full	Medium	None	None	None		None	None	8 lb 6 oz	None	Good	
1938	I L	26	I	R O P	32	4	7	Full	High	Morph. 1·0 Pit 1·0	Med episs	None		None	None	7 lb 4 oz	Cath	Good	
1938	B P	21	I	L O P	31	28	?	Full	Medium	Morph 1·0	Med episs	None		None	None	6 lb 10 oz.	None	Good	
1937	H W	21	II	R O P	26	4	1	Full	Medium	Pit 1·0	None	None		None	None	7 lb 7 oz	None	Good	Twin of twin
1938	P C	19	I	R O P	9	6	4	Full	Low	None	Med episs	None		None	None	8 lb 3 oz	Cath for 48 hrs	Good	
1938	M G	23	I	L O P.	21?	17	5	Full	Medium	Morph 1·0	Med episs.	None		None	None	8 lb 5 oz	None	Good	
1938	G S	23	II	L O P	18	8	2?	Full	Medium	Pit 1·0	Med episs.	None		None	None	10 lb.	None	Good	
1938	E	21	I	L O P	42?	18	5	Full	Medium	Morph 1·0	Med episs.	None		None	None	7 lb 7 oz	None	Good	
1938	C C	27	I	R O P	37	3	3	Full	Medium	Morph 1·0	Med episs	None		None	None	8 lb 4 oz	None	Good	
1938	I I	21	I	O S	41	2	5	Full	Medium	Morph 1·0	Med episs.	None		None	None	7 lb 7 oz	None	Good	

anæsthetist at hand. The average weight of the babies delivered was 8 pounds. The largest baby weighed 11 pounds, 8 ounces. The smallest baby weighed 5 pounds. There was no maternal mortality. There was no fœtal mortality as a result of the delivery. Five babies were born dead, but death in these cases resulted long before delivery. One of these was born macerated; in the other 4 cases the fœtal heart disappeared hours before the delivery. These were neglected cases.

The morbidity was exceptionally low. Only two cases ran a febrile course. One had a temperature of 102° F. for 13 days. This was a case of toxœmia of pregnancy with a temperature of 102° F. before the delivery. The second case ran a temperature of 101° F. for 8 days. This patient had an infected perineorrhaphy wound. The rest of the patients (58) ran a normal puerperal course and left the hospital on the tenth day postpartum.

There were no pelvic injuries sustained beyond the ordinary perineal lacerations met with in the average forceps case. There were no discernible bladder injuries; and no urinary disturbances with the exception of 10 cases that had the usual expected dysuria for a few days as a result of prolonged pressure of the head on the base of the urinary bladder.

One patient sustained a laceration of the cervix as the result of a hurried extraction of the head with a cervix incompletely dilated. It required two sutures to repair the tear. The babies fared exceptionally well. The injuries sustained by them were very slight and then only by the larger babies. They were in the form of mild abrasion of the face which healed in a day or two. There were no manifest injuries to the babies' heads. Of the 60 babies 49 had no discernible injury whatsoever. They all left the hospital with the mothers in good condition.

There was not a single instance when the "two-forceps manœuvre" failed to give the desired result.

As regards the amount of experience necessary for the successful performance of this manœuvre, I would state that the house surgeons at the Jewish Maternity Hospital, on being shown the steps and learning the principles of the operation, are able successfully to perform it with remarkable ease. This manœuvre is also admirably adapted for cases of occipitotransverse position.

In view of the safety of this operation as demonstrated by the above results, and the ease with which it is carried out I believe that the "two-forceps manœuvre" ought to be resorted to early in the second stage, that is soon after complete dilatation is effected. There is little gained by waiting until a critical stage is reached. In the present age of prophylaxis when leaders of obstetrics are enthusiastic about eliminating the second stage of labor in normal cases and advocate prophylactic forceps and episiotomy and prophylactic version, the elimination of several hours of severe, agonizing, and unproductive pains in cases of occipitoposterior positions is not only justifiable but commendable.

The policy of allowing a patient with an occipitoposterior position to labor for hours after full dilatation, in the face of intense suffering and threatening dangers, in the hope that nature may eventually effect a correction of the malposition, is to say the least inhuman and ought to be discarded in favor of the safe, comparatively easy and uniformly successful "two-forceps" operation.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
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MARCH, 1923

INTRACRANIAL INJURIES OF INDEFINITE LOCALIZATION

SURGEONS, who frequently deal with cranial traumatisms, have learned that the problems presented differ widely and are often extremely difficult to solve, particularly in that class of cases where there is an absence of localization and no visible fracture. Such cases often cannot be diagnosed. We are uncertain as to the existence of a hæmorrhage or an œdema or basilar fracture, a compression, or a concussion, the latter which is present in the majority of instances soon disappears. The outstanding condition that chiefly concerns the surgeon is a compression. It is unimportant whether the intracranial compression is due to concussion, contusion, an œdema, a hæmorrhage or a fracture usually associated with unconsciousness. It is often impossible to determine which of these may be the more important factor or factors. One or several of these symptoms co-exist and a localization is impossible. We may, however, accept a condition of cerebral compression when it is present as a determining factor for or against surgical attack. The fate of the case will depend upon the ability of the surgeon accurately to determine approximately the amount of pressure and whether the brain will be able to withstand the amount of existing pressure and the means to be adopted for its relief.

We must not forget that brain tissue reacts to traumatism as any other tissue save for the unyielding nature of the bony cavity in which it is inclosed, consequently œdema and hæmorrhage pressing on the unyielding brain would be a greater menace than in structures in any other part of the body. A certain amount of pressure would be tolerated by displacement of the cerebrospinal fluid and cause so little pressure on the easily compressible venous circulation as to give little or no evidence and end in resolution. However, we often observe cases where compression interferes to a marked degree due to a pronounced venous engorgement usually manifested by headache and more or less mental dullness, irritability, dizziness, etc. Then we find a type that presents, almost from the beginning, unconsciousness without localizing focal symptoms, with a decreasing blood pressure and a rapid pulse. Another type presents unconsciousness immediately after the injury, with stupor, irresponsive to reflexes, slow pulse, large pupils, choked disks, and this condition is often terminal. The phases between these extremes are many.

Cases of shock, as shown by rapid pulse, low blood pressure, cold skin, large pupils, subnormal temperature, should not be operated upon. Another class, as medullary failure, which may be recognized by a rapid and irregular pulse, a low blood pressure, rapid respiration, muscular relaxation and stupor

do not come in the operative class. They may be difficult to distinguish but that is not of practical importance; both must be treated expectantly. Most of these die if they are operated upon.

This leaves for operation cases of intracranial pressure. Sometimes pressure signs are positive but quite as often they are uncertain. The usual case that calls for an operation presents immediate unconsciousness that does not clear up, choked disks, lumbar puncture that indicates increased intraspinal pressure, slow pulse, increased blood pressure; with this clinical picture delay is dangerous.

Those cases with primary consciousness which become unconscious later with any or all the above symptoms, are surgical. Spinal punctures should be used more often. Mercury manometer indicates the degrees of intraspinal pressure in cases of intracranial injury and, further, sometimes the fluid shows blood, indicating intradural hæmorrhage. In doing a spinal puncture, one should ever have in mind the possible herniation of the medulla into the foramen magnum, particularly where the spinal pressure is unusual.

An increasing experience has taught that the operation of choice is one that will give exit from the cranial cavity such fluids as are responsible for the compression, and the operation of choice is a decompression with a sacrifice of a small piece of bone. The large osteoplastic flap has given way to a relatively small loss of bone and is done after the method of Cushing by removing a disk from beneath the temporal muscle and opening the dura. This operation has proved effective and avoids, to a greater or less extent, the large postoperative brain hernias following the removal of the large plates of bone higher up. The subtemporal opening affords ample drainage in cases of œdema, and, if there is a hæmorrhage from the middle meningeal, it can be effectively dealt with.

A. F. Jonas.

APPREHENSION

ANATOLE FRANCE, in one of his delightful essays, says that fiction gives greater happiness in the world than truth. Science searches patiently for facts; the truth and nothing but the truth must be recognized. Yet truth of itself is not a fixed quantity which can be subjected to physical standards of comparison. It can be measured and weighed only in relation to a limited number of facts. What appears to be the truth under given circumstances, when subjected to scrutiny from different standpoints, may no longer represent the whole truth.

In the practice of the art of medicine scientific ideals sometimes are the cause of failure to give the patient the relief which might be afforded because the truth as seen by the physician prevents him from doing the things that would place the patient's mind at rest. The trained physician unconsciously tends to become materialistic. We admit that thoughts are the result of the function of a material organ, the brain, but because thought cannot be measured and weighed it is regarded as non-existent, and immaterial. It has been said, more or less justly, that apprehension not justified by the event is the cause of three-fourths of the sorrow and tribulation in the world. Abernathy, the greatest physician of his time in England, said that the secret of his success was in always giving the patient definite advice with a program of treatment to follow.

Surgery offers fairly measurable and definite results in specific cases. The surgeon speaks with a certain amount of dogmatism because he is dealing with material things. There are a number of patients, however, on whom

operation is performed who have, besides their surgical ailment, a nervous condition which continues after the removal of the cause; or patients on whom operation is performed secondarily for the relief of a condition which is primarily non-surgical. The patient may be relieved of his physical disease, but the surgeon sometimes fails to realize the importance of ministering to the patient's unstable mental state, by quieting his mind, or by giving him such advice as will enable him to endure more cheerfully burdens that cannot be relieved.

When a person is ill, he and those interested in him are anxious and feel that something should be done. They do not know whether the trouble is functional, self-limited, or largely the result of apprehension. It is to this human attribute, apprehension, that the popularity of patent medicine is due. The nervous, depressed person finds temporary relief in the mental stimulation which follows the use of an alcoholic patent medicine. It is with such patients that practitioners of cults and quackeries obtain their greatest advantages. With a lack of knowledge and a lack of common honesty they are yet able to quiet apprehensions. Their success obviously lies in the comfort given, and their failure in their inability to interpret correctly the facts, and to relieve patients with ailments that yield only to medical or surgical treatment.

The mental states which we designate insanity depend not so much on fixed material criteria which may be evaluated, as on the disturbed relations of the patient to his fellowmen. So-called Christian science, so far as it relieves apprehension, gives mental comfort, but to reach one's hand into the air, withdraw it, and say, "See what I have in my empty hand," requires great imagination. Christian science is beyond the comprehension of most persons. The average person requires material evidence; the Chinaman requires the wooden Buddha, the hypnotist the crystal ball. For such osteopathy is made to order. It is based on the premise that a material thing, the bony frame, is the basis of all human discomforts, physical and mental. Its greatest weakness lies in the comparison the patient can make between his own anatomy and that of others. It is through this weakness that chiropractic has stabbed osteopathy in the back. Every person knows that he has a spine, but it is behind him, and he cannot get those enlightening comparisons with the anatomy of others which are open to the osteopathy patient. The unrelieved distress which comes from functional, nervous conditions which are true to the patient, although false to the diagnostician, puts a strong argument in the hands of mercenary persons and their deluded followers who persuade state legislatures to permit chiropractors, osteopaths, and so forth, to practice.

The three greatest enemies of mankind are: tuberculosis, cancer, and the so-called neuroses. On these we need more light.

William J. Mayo.

MASTER SURGEONS OF AMERICA

CHARLES McBURNEY

DURING the decade from 1890 to 1900—the height of his professional career—Dr. Charles McBurney held rank as one of the greatest if not the leading figure in American Surgery. His workshop, the Syms Amphitheater of the Roosevelt Hospital, planned by him and built under his direction, was at that time one of the finest surgical amphitheaters in America, and a Mecca for American as well as foreign surgeons. His work typified the highest development of aseptic surgical technique, then still in its infancy.

Dr. McBurney was born February 17, 1845, in Roxbury, now a part of Boston, Massachusetts. His father, of Scotch-Irish birth and parentage, came to this country as a boy, and followed a manufacturing and commercial career. His mother, Rosine Horton, was of New England stock, her ancestors being among the oldest families of Maine and Massachusetts.

Dr. McBurney received his preparatory education in the Roxbury Latin School, and in a private school in Boston.

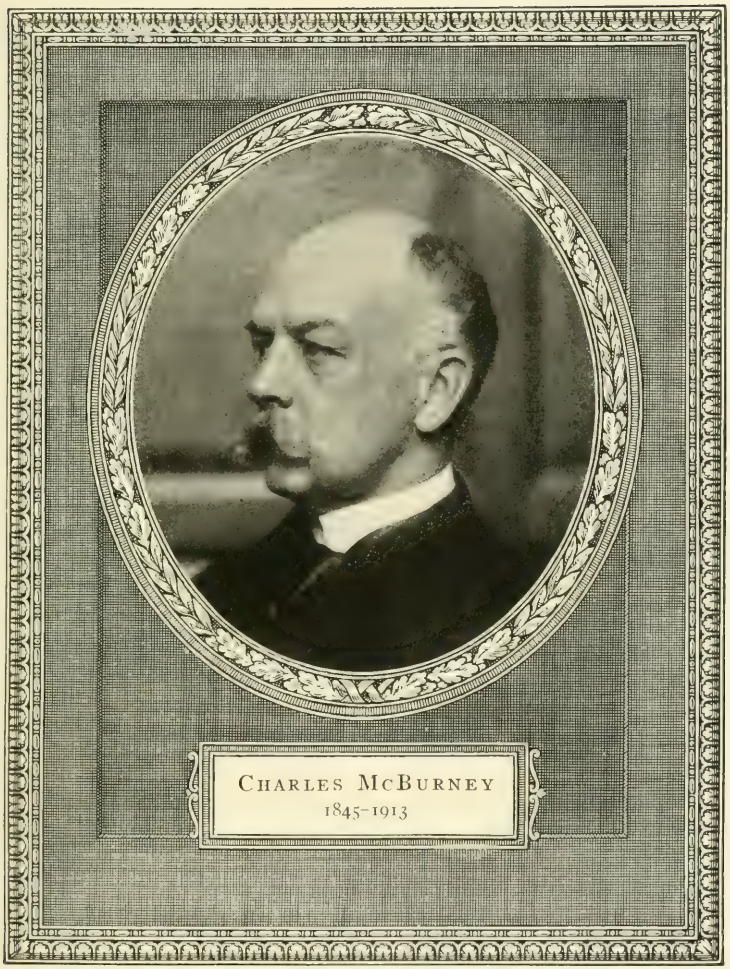
In 1862 he entered Harvard University, receiving the degree of Bachelor of Arts in 1866 and Master of Arts in 1869. In 1870 he was graduated in Medicine from the College of Physicians and Surgeons of New York.

After a surgical interneship of 18 months in Bellevue Hospital, he went abroad, pursuing his studies in surgery and surgical specialties in Vienna, Berlin, Paris, and London. In 1873 he began practice in New York, and a year later became associated with Dr. George A. Peters, a connection which lasted until Dr. Peters retired from practice 10 years later.

His teaching positions were exclusively with his alma mater, and in the period from 1873 to 1804 were successively, assistant demonstrator of anatomy under Dr. Henry B. Sands, demonstrator of anatomy, lecturer on the anatomy of nerves (1878–1880), lecturer on operative surgery (1882–1889), professor of surgery (1889–1894), professor of clinical surgery (1894–1900). He was appointed attending surgeon to St. Luke's Hospital in 1875, to Bellevue Hospital in 1880, and in 1888 as successor to Dr. Sands was placed in charge of the entire surgical service of the Roosevelt Hospital, a position which he held until 1900, and which during that period was perhaps the most notable surgical service in this country.

He held at various times the position of consulting surgeon to the New York Hospital, St. Luke's Hospital, the Presbyterian Hospital, the Hospital for Ruptured and Crippled, the Orthopedic Hospital, and St. Mark's Hospital.

He was a member of the New York Surgical Society, the New York Academy of Medicine, the Medical and Surgical Society, the Practitioners Society, and the



CHARLES McBURNEY
1845–1913

Roman Medical Society. In Europe he held a fellowship in the Royal College of Surgeons of Edinburgh, Scotland; he was also a corresponding member of the Societe de Chirurgie of Paris and an honorary member of the Medical Society of Constantinople.

He devised several new procedures in surgical work and his contributions to surgical literature were many and important. The most notable, perhaps, were connected with the subject of appendicitis.

His paper entitled "Experience with Early Operative Interference in Cases of Disease of the Vermiform Appendix," published in the *New York Medical Journal*, December 21, 1889, in which he emphasized the importance of localized tenderness at "McBurney's point," was a classic, and a designation of the outstanding physical sign of the disease in its early stages, which will always be associated with his name, as will the intermuscular incision which he also introduced (in 1894), the "McBurney incision." In the next few years five or six other important articles on appendicitis from his pen appeared in medical journals or in surgical textbooks.

His attempt to devise an operation for the radical cure of hernia was not so successful, but was an evidence of his activity in seeking to improve the surgical procedures of his time. Other important contributions to surgical literature, some of them introducing new procedures were:

"Dislocation of the Humerus Complicated by Fracture at or near the Surgical Neck, with a New Method of Reduction." *Annals of Surgery*, April 1894; "Removal of Biliary Calculi by the Duodenal Route (a new Operation)," *Annals of Surgery*, 1898; "The Use of Rubber Gloves in Operative Surgery," *Annals of Surgery*, July, 1898; "Remarks Concerning the Practice of Aseptic Surgery," *New York Medical Journal*, March 22, 1902; "The Technique of Aseptic Surgery," *International Text Book of Surgery*.

He was one of the early and consistent advocates of the use of rubber gloves, and his teaching did much to make their adoption universal.

His increasing and extensive private practice necessitated his relinquishing the chair of surgery at the College of Physicians and Surgeons in 1894, but he continued as professor of clinical surgery until he gave up active hospital work.

He was called as consultant to the bedside of President McKinley a few days before his death.

Although a good student of his specialty, Dr. McBurney was not a scientist in the restricted use of the term, but shone by his strong common-sense in his attitude toward his patients. He could not have been called a "brilliant" operator, but his lack of hesitation, founded on the care with which he planned every operation and the thoroughness with which he completed each step before passing to the next, resulted in a great saving of time and left the spectator with the profound impression that he had seen a "Master of his Art" at work. Bold, yet a great respector of tissues, the finished result of his operations left little to be desired.

Dr. McBurney was a true sportsman and fond of out-door life. He was an expert shot and salmon fisher. All his life he took a great deal of out-of-doors exercise. During his interneship at Bellevue, he rowed almost daily on the East River in a single shell and up to the end of his life was an ardent devotee to golf.

His last years were saddened by ill health which drove him into retirement in 1905, nine years before his death.

His career marks a brilliant epoch in the development of American surgery and his name will go down to posterity as one of the strongest and ablest men, who have helped to bring it to the forefront as it stands today.

Charles H. Peck.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held November 17, 1922, Dr. Henry F. Lewis, Presiding

REPORT OF THREE CASES OF ABDOMINAL SECTION FOR UTERINE FIBROID AFTER THE USE OF RADIUM

Dr. Thomas J. Watkins: Case 1. Mrs. M., age 41, had a symmetrical fibroid, the size of a two and one-half months' pregnancy. The uterine canal was 4 inches deep. November 23, 1921, 900 milligram hours of radium, single screen, were given. Two menstruations followed the radium treatment; the first was scant, the second of normal amount. Amenorrhœa persisted for 8 months. Examination on February 6, 1922, showed no decrease in size; no increased hardness; November 8, 1922, patient reported menstruation in September and October which was quite free. The uterus then was about the size of a 3 months' pregnancy; the tumor more of a subserous type. November 13, 1922, abdominal section revealed a fibroid tumor, extremely soft and œdematous; ovaries, normal, one containing a recent corpus luteum.

Case 2. Mrs. Z., age 43. The uterus was 3¼ inches deep. Patient suffered with endocervicitis, small cystocele and rectocele. Menstruations were about normal. She gave a bad hereditary history of cancer. April 28, 1922, radium, 1,800 milligram hours, was given in cervix and body of uterus. No fibroid was found. Radium was used partly for infection and partly as a prophylactic for cancer. August 1, 1922, the uterus was senile in size. November 1, 1922, recent hæmorrhage, first since radium was used. The uterus was about the size of a 2 months' pregnancy. The uterus was 3¾ inches deep; a fibroid nodule was felt with the curette. Abdominal section revealed a very soft œdematous fibroid, partly subserous, 2 to 3 inches in diameter. The ovaries were senile in appearance.

Case 3. Miss S., age 50. Patient was very anæmic and had a cardiac valvular lesion. The uterus was the size of a 4 months' pregnancy. May 8, 1922, radium insertion, double screen, 1,500 milligram hours. Tumor was located chiefly in the anterior wall of the uterus. July 20, 1922, no decrease in size was apparent but general condition was much improved. Amenorrhœa has persisted since radium treatment. October 16, 1922: patient has had some bleeding from uterus. Abdominal section revealed a very soft œdematous fibroid making the uterus the size of 4½ months' pregnancy; ovaries are senile.

The soft œdematous fibroid is probably the result of destruction of the small blood vessels by the radium. Destruction of the veins interfered with absorption which was probably the reason why these cases required operation after using radium,—an uncommon result in our experience.

The circulatory disturbance probably caused recurrence of the bleeding in the two cases with senile ovaries. The swelling which resulted probably activated the uterus.

DISCUSSION

Dr. Charles E. Paddock: If I understood Dr. Watkins correctly, he stated that he would not care to use radium on a patient under 45 years of age. What treatment would he pursue in cases of single fibroids of the size of an orange or under? Again, is it not a fact that most of his patients with fibroids were under forty-five? Is it not a fact that in most of the cases in which he has used radium the patients were under 45? I should like to know if Dr. Watkins is going to abandon that line of treatment. Again, what percentage of his cases become sterile after this treatment with radium? How long does the sterility remain? I have one case in which Dr. Watkins used radium; the woman became pregnant subsequently. Two cases in which I personally used radium became pregnant within a year.

Dr. Charles S. Bacon: I would like to ask Dr. Watkins what his objection is to using radium if bleeding returns? If it is good once, why is it not good a second time?

Dr. N. Sproat Heaney: I thoroughly agree with Dr. Watkins in advising more conservatism in the treatment of fibroids with radium. Those who were the first enthusiastic advocates of radium in all classes of cases are now being followed by the profession at large, and trouble is produced. There is a prevalent idea that a case of fibroids can either be operated upon or treated with radium. I believe that the indications for treatment by each method are well defined.

Dr. Watkins mentioned one case where he operated upon a cystocele and rectocele and in the same patient at the same time applied radium for the treatment of fibroid. I believe that if a case is operative at all, it should be wholly operative; nothing is gained by a combination of the so-called non-operative with the operative procedure.

I believe that the cure of the fibroid is dependent upon destroying its blood supply by producing an endarteritis of the vessels supplying the fibroid nodule and that this is the primary effect of the radium in the treatment of a fibroid. A secondary effect is produced through the action of the radium upon the ovaries. I believe that the general results of treatment for fibroids with radium would be more satisfactory if, except in particular cases only, small tumors were treated.

Dr. Carey Culbertson: Dr. Watkins reports recalling to my mind a case that was treated with radium last winter which shows, on the other hand, the advantages of radium where the patient is not a good operative risk. This patient was a woman, 38 years of age, who came complaining of pain in the legs due to a large fibroid impacted in the pelvis, with a fairly good sized pedunculated fibroid superimposed on top of it. Under ordinary circumstances she would have been operated upon, but she had a marked nephritis, with casts of all sorts and an abundance of albumin in the urine. So I did not regard her as a good operative risk. I gave instead 72 milligrams of radium for 24 hours. She ceased menstruating. Two months later the fibroid, which had been fixed, was freely movable, and appreciably smaller in size, and the symptoms of pressure were entirely relieved. I then gave her another dose of radium of the same size, and I saw her again this fall, and she feels very comfortable now, although she still has a large fibroid. Her nephritis has not appreciably improved.

Dr. Heaney brings up an important point in treating cases that come to us for treatment by radium.

I had a patient sent to me last year from down state by a physician who had told her that I would give her radium. I had never seen her before her arrival at the hospital. She refused to have a dilatation of the cervix because the doctor had told her that she did not need to be operated upon. It took me an hour, after I had her in the operating room, to persuade her and the husband that in order to introduce radium in the uterus it would be necessary to dilate the cervix.

Dr. Watkins (closing): Forty-five years is an arbitrary age which we assume as being near the menopause. If radium is used before that age the amenorrhœa is quite liable to be only temporary, and before that age we assume it is better to remove the tumor by surgery than to injure the ovaries with radium. We have had no case of pregnancy following large doses of radium but have had following small doses in the cervix, for endocervicitis.

In reply to Dr. Bacon, we have in occasional cases repeated the radium treatment. In the cases reported above, it seemed better to operate than to repeat the treatment.

In reply to Dr. Heaney, I concur with him in what he says relative to the destruction of small blood vessels as a curative factor in radium therapy. In these cases it did not, however, act according to expectations. Like Dr. Culbertson we have had radium act well in tumors which would not be considered desirable cases for radium treatment, an experience which illustrates the fact that indications can be extended in poor surgical risks.

We frequently use radium and operate at the same time, and have had no case where the radium seemed to interfere in any way with the results of the operation.

Exhibition of Fibroid with Pregnant Uterus

Dr. Albert Goldspohn: About 8 weeks ago I removed this specimen from a small maiden lady, a domestic, who came to me suffering with a large tumor. On close examination it was quite evident that she was also pregnant. She gave a history of having the usual amount of nausea in the earlier months of pregnancy. At this time she was 5 months pregnant. An odd feature in the diagnosis was that vaginal examination revealed nothing except this mass which filled the pelvis. The cervix could be reached only by inserting the fingers up above the upper border of the symphysis where a dimple of the external os could be felt. This large tumor was in the upper part of the abdomen lying to the left above the umbilical line, encroaching upon the thorax. This mass I show you is the uterus which has contracted materially, as you will see, because it contained the intact ovum, a fœtus of 5 months, which greatly crowded these masses up against the thorax.

From her history it was evident that she had become greatly disabled and was confined to bed at home in a distant state, for several weeks. It was thought that she had peritonitis, by the family doctor. She was a small creature, only 4 feet and 10 inches high. She weighed usually 110 to 115 pounds. The abdomen was greatly distended, respiration difficult.

I had Dr. Bacon examine the case in consultation before treatment. Every one who examined her was impressed with the necessity of operating on her. No one thought it would be better or safe to wait another 3 months, for a viable child, for that would have created such a deplorable condition in that woman that she would not have been able to withstand the necessary cæsarean section with the removal of the tumor also. I had an idea that if cæsarean section only were done in the presence of the fibroids, there would be serious difficulty in stopping the hæmorrhage, so that it would result only in a very bad prognosis. I therefore decided that operation should be done as soon as the patient could be gotten into a little better condition.

The surgical treatment of the case went smoothly and everything healed finely; but about one week after operation the patient began to have delusions which at times improved a little, but in the course of 4 weeks, while we had her under our care, these delusions became more and more fixed, so that we

were obliged to transfer her to the Psychopathic Hospital.

You will notice in the larger tumor a very considerable breaking down of the fibroid; and there were extensive recent adhesions throughout the upper part of the mass showing that peritonitis really had been active there, as a result of rupture of degenerated foci near the diaphragm.

DISCUSSION

Dr. Thomas J. Watkins: I presume from what Dr. Goldspohn has said that his patient could not well have been left to go to term and be relieved by Porro operation. As a general proposition, in cases of fibroid tumors with pregnancy, I believe that they should almost invariably be allowed to go to term and be delivered by cæsarean, followed by excision of the fibroid uterus. Results have demonstrated that the recoveries are smoother after a Porro than a cæsarean operation, and the supravaginal hysterectomy is not made more difficult by the pregnancy if the circulation is carefully controlled by clamp forceps before incising.

Dr. Charles S. Bacon: There were one or two features about this case of Dr. Goldspohn's that were not mentioned by him that might be brought up. The fact that the child was illegitimate is one, and another is that the woman was of very low mentality. Nevertheless, if the child were legitimate and the woman was anxious for a child, I do not believe it would have been the wise thing for her to carry the child until it was viable considering the condition she was in. I understand she had some kidney involvement.

Dr. Goldspohn (closing): Yes, she had albumin in the urine. I do not think that if any of you gentlemen had examined this patient and had seen the condition she was you in, would question the procedure I resorted to in this case. The child was illegitimate, and she tried to deny it. I do not believe that she knew what was the matter with her. She had been seen by other physicians, who recognized a tumor with peritonitis, and recommended operation. The man who is responsible, instead of taking that advice, brought her to this city and deserted her in a railway station, with the advice to inquire for and to find the County Hospital. Even if the conditions had been more favorable, and if she had known she was pregnant and desired to have a child, I doubt whether it would have been sound judgment to have entered upon such a venture in this case.

Dr. Charles E. Paddock: There was no doubt that the operation was indicated, but why lay such great stress upon the fact that the case was an illegitimate one? There were good reasons for operating but because the unborn child was illegitimate was not one of them.

BIRTH CONTROL AND STERILITY

Dr. C. Henry Davis, Milwaukee, Wisconsin: A childless marriage may be a happy one but is never the happiest. There are very few normal women who do not desire a home and children. This is equally true of men. We are, therefore, justified in assuming that some form of sterility is as a rule responsible when a union continues childless over a period of 5 or more years. Too often friends and relatives add to the secret sorrow by chiding the unfortunate couple for not wanting children or using "birth control."

Conception is dependent on the following conditions:

1. The deposit of living, active spermatozoa in the upper portion of the vagina;

2. The passage of active spermatozoa through the cervical canal and uterine cavity into the fallopian tube;

3. The passage of a healthy ovum from the ovary through the tube at a time when active spermatozoa are present;

4. The fertilized egg must find a resting place where it can develop until the period of viability.

All four conditions must be fulfilled. It is evident, therefore, that the sterility may be due to faults of either husband or wife and no examination is complete which does not include a microscopic test of the semen. The husband may have active spermatozoa and yet be responsible for the sterility. Latent gonorrhœa in the male may cause a low-grade infection in the woman with permanent closure of the tubes. Findley states that one marriage in ten is non-productive and that in at least one-sixth of these the man is sterile.

In the study of sterility cases I have long been impressed with the factor of birth control in causing many functional cases and gradually have come to believe with Dr. Englemann, "that the avoidance or the prevention of conception if possible, the premature termination of pregnancy if need be, are factors far more potential of causation of decreasing fecundity than is the progress of genetic science to the contrary." The subject "Birth Control and Sterility" therefore seems a fitting one for discussion. Dr. Child, in his monograph on "Sterility and Conception," considers "all of the artifices that are used for the prevention of conception or the limitation of offspring injurious alike to morals and to physical health." He quotes the following from Dr. Goodell:

"The sexual instinct has been given to man for the perpetuation of his species: but, in order to refine this gift and to set limits to its abuse, it has been wisely ordered that a purely inellectual quality—that of love—should find its most passionate expression in the gratification of this instinct. Dissociate the one from the other, and man sinks below the level of the brute. Destroy the reciprocity of the union, and marriage is no longer an equal partnership, but a sensual usurpation on the one side and a loathing submission on the other; wedlock lapses into licentiousness; the wife is degraded into a mistress; love and affection change into aversion and hate."

Birth control may be practiced without danger of conception when one or both parties are actually or potentially sterile. If both parties are virile sooner or later there is a mishap and pregnancy results. Those who merely aimed to postpone the pregnancy accept this with good grace—but all too often the woman is rushed to the abortionist while still in the hysterical stage and her life and future health jeopardized.

Birth control to be at all effective demands a considerable degree of intelligence and self-control. By virtue of this fact it can be of little value to the class of people for whom the enthusiasts, like Mrs. Sanger, say it is intended. The more highly educated woman usually marries after twenty-five when she has already passed the period of greatest fertility. If she then uses contraceptives for a few years she often becomes potentially sterile and medical treatment may be required before a pregnancy will result. Furthermore, in many instances, the unnatural sexual practices have made her more or less neurotic. These cases are apt to end in a sanatorium or a divorce court.

In the study and treatment of sterility cases I have endeavored to utilize the suggestions made by Reynolds, Child, Watkins, Rubin, and others who have written on the subject. However, in this paper no attempt will be made to detail treatment or discuss the merits of various procedures. The following general plan is the one I have used during the past 3 years in treating women who complain of sterility:

1. A carefully taken history is important;
2. A thorough physical examination with special attention to pelvic organs is needed;
3. Test spermatozoa, having the woman come to the office immediately after intercourse;
4. If the pelvic examination is negative and the spermatozoa active the woman is placed on medical treatment. Intercourse is permitted at not less than 3-day intervals during the 2 weeks following menstruation and none during the balance of the month;
5. If a pregnancy does not result within a few months she is advised to have an inflation test to determine the patency of the tubes;
6. Surgical treatment is advised where pathology demands, but rarely with much hope of relieving the sterility;

The advice given patients, the nature of treatment and end-results may best be given by briefly reviewing a few typical cases:

Case 1. Mrs. B., age 38, was very anxious to have a baby, but she gave a history of an induced abortion at age 20, a spontaneous one at 24 and a second criminal abortion when 28; this was followed by contraceptive methods. Examination showed tubal involvement on both sides. The semen test was normal. Tubal inflation was not advised in this case. She has pelvic pathology and eventually will require surgical treatment.

Case 2. Mrs. J., age 28, complained of amenorrhœa of 1 year's duration and sterility. Five months after marriage she stopped menstruating without becoming pregnant. Examination of pelvis was negative but she presented a typical picture of pituitary dysfunction. She was given thyroid extract 2.5 grains, 2½ t.i.d. and 1 tablet ovarian extract t.i.d. starting May 6, 1921. She menstruated in June and July. July 22 she was given calcium lactate 10 grains daily. There was no flow in August and September 26 a diagnosis of early pregnancy was made. May 18, 1922, she was delivered of a healthy female baby.

Case 3. Mrs. H., age 27, had been married nearly 4 years and had taken no precaution against pregnancy after the first year. Examination showed normal pelvic organs with the exception of a chronic cervicitis and endocervicitis. After 3 months of local treatments this condition was relieved, and the spermatozoa were found active 30 minutes after intercourse. With a sterile applicator, seminal fluid was passed from vaginal vault into the upper portion of the cervix. She missed the next period. At 2½ months she miscarried. Four months later she again became pregnant and August 22, 1922, was delivered of a husky boy.

Case 4. Mrs. A., age 22, married 1½ years, gave a history of precaution during first year, but none since. She has never reacted with intercourse. Examination showed normal genitalia. She was given ovarian extract t.i.d., and a few local treatments to clear up a slight cervicitis. The husband was given instruction regarding intercourse. She became pregnant following the next period.

Case 5. Mrs. P., age 23, had three miscarriages, due in part at least to a retroflexion of the congenital type. I shortened the round ligaments by the Webster-Baldy method and the uterosacrals by sewing to back of the cervix. Eight months later she became pregnant and was delivered of a healthy boy at term. The uterus has remained in good position since the delivery.

Case 6. Mrs. J., age 21, married 2 years and has used no precaution since the first year. The uterus was retroposed but otherwise normal. She was instructed to limit intercourse to the first two weeks after a period. Calcium lactate, 5 grains, was administered twice daily and ovarian extract t.i.d. She had one more period and is now nearing term.

Case 7. Mrs. H., age 26, gave a history of precaution during the first 2 years of married life but none for nearly a year. Examination showed the uterus to be of the infantile type and retroposed. The ovaries were small. She was given ovarian extract t.i.d. and instruction regarding intercourse. After three more periods she became pregnant and at term was delivered of a healthy boy.

Case 8. Mrs. E., age 22, married 16 months, complained that intercourse was impossible. Examination showed a rigid hymen with small opening. She menstruated only once after the hymen was dilated and in due time was delivered of a healthy girl.

Case 9. Mrs. K., age 27, first seen following

criminal abortion which was incomplete. Curettage was necessary owing to hæmorrhage. This was followed by temperature for over 2 weeks. This was her second criminal abortion. She is now very anxious to have children but has remained sterile for over 3 years.

Case 10. Mrs. W., age 28, married 2 years, had used no precaution and had taken treatments for sterility. Examination of the semen on four occasions showed no spermatozoa. The husband had an epididymitis before marriage and is sterile.

Case 11. Mrs. L., age 29, married 1 year, had never taken precautions. Examination showed enlargement and tenderness of both adnexa. Spermatozoa were active and husband denied gonorrhœa. In the tubal inflation test some gas passed at 190 millimeters, but only under high pressure. Six months after this test she developed acute pelvic symptoms and subtotal panhysterectomy was necessary because of bilateral pyosalpinx. Cultures were negative and the sections showed that it was due to tuberculosis.

Many more cases might be cited with their individual variations in findings and treatment. I have had several girls who had never menstruated because of congenital defects and they, of course, will never become pregnant. In other cases the women had closed tubes due to gonorrhœa contracted before marriage or later from the husband. In a few cases hæmatogenous infections had caused closure of the tubes and thereby permanent sterility. A few men due to excessive intercourse were functionally sterile as the spermatozoa were immature and weak. On the other hand I have had within the year at least ten women who became pregnant while using "birth control precautions." Therefore, I have come to the following conclusions:

1. A long-continued prevention of conception is possible when one or both parties are sterile or potentially sterile;

2. If both parties are virile soon or later a pregnancy will result in spite of contraceptives;

3. The use of contraceptives tends to produce a functional sterility;

4. A criminal abortion is apt to result in a permanent sterility;

5. The average girl of today leads a life which tends to reduce her fertility. She will have a relatively small family even though no precautions are used, and attempts to postpone pregnancy may result in her having no children;

6. The advocates of legalized "birth control" are a menace to civilization. Sterilization is the only thing which will stop the reproduction of the subnormal and unfit. Practiced clandestinely, birth control does much harm and little good; if legalized, it would in a few generations destroy our civilization and leave a race of degenerates;

7. Functional sterility can usually be corrected if both husband and wife will co-operate with the physician and continue treatment for a sufficiently long period.

DISCUSSION

Dr. Rachelle S. Yarros: I am glad that Dr. Davis has brought this subject before your society for discussion. I am sure you all realize fully that birth control is a fact and not a theory; that it has been and is being practiced in all civilized communities. The question really is as to methods and as to who should supply the information. Shall we leave it to the public to continue to gather scraps of information regarding methods of contraception, with a large proportion of failures and with the danger of using injurious methods and frequently resorting in desperation to abortions, or shall we doctors learn all the modern methods and intelligently advise contraceptives in appropriate cases?

In the United States physicians, other professional people, as well as people generally of culture and refinement, usually have small families. This is not a mere accident. Most of them do not believe in sex relations for procreation only; consequently they are practicing birth control, apparently without that detriment to health, character or danger to civilization which Dr. Davis fears.

In France, Holland, and England, where methods of contraception have been better understood and practiced, we have no evidence of any deterioration resulting from birth control. The French and Holland peasants have had to practice birth control for economic reasons.

I have numerous cases that disprove the statement that when people once begin to use contraceptives they are not likely to have children except by accident. I can quote case after case among the poor, as well as among the educated and well-to-do families, who either for reasons of their own or upon my advice used contraceptives for years and then deliberately decided to have children, and in most cases they had them without difficulty.

Dr. Rudolph W. Holmes: I would like to call attention to the fact that Dr. Davis' first premise is not absolutely indispensable, namely, that semen must be deposited in the vaginal vault. I have done a cæsarean section twice on a woman who never has had coitus completa on account of such extreme distortion of the rami and sacrum that the vagina would not admit a finger. Similar instances are on record.

I believe our federal and state laws are wrong in making it a penal offense to use contraceptives, or even to suggest their use. However, contraceptives may be bought or sold, but as in the case of abortion they are classed as criminal procedures.

There are times when it is absolutely necessary to prevent conception, as in the case of heart disease, tuberculosis, kidney disease, general malnutrition, chronic invalidism. In aggravated cases of such it is a serious menace to the woman to bear children. It is a poor policy to advocate that the poor woman should bear a child yearly—such begets poor quality of manhood and womanhood. It is infinitely better to bring one or two children up well than a large brood poorly.

In spite of the law, people are using contraceptives, and the sentiment against their prohibition is so strong that they will continue to be used. There is a wrong and a right method of prevention; the former should be discountenanced.

Dr. William C. Danforth: In our discussion of this subject I think it is important to determine the male function. The physician should have samples of semen for examination.

Dr. Davis quoted Dr. Findley as saying that one-sixth of sterile marriages are chargeable to the male partner. In my own experience the percentage runs quite decidedly over that; I should say at least one-third in the cases which have come under my observation presented specimens of semen which were quite decidedly deficient, the sperm being absent or non-motile. Of course in these cases one should not operate on the woman. We find a relative sterility in men, particularly in large cities where we are dealing with men who live under high tension, who work long hours under considerable mental strain. These may acquire a functional sterility.

After the last epidemic of influenza I saw three women, whose husbands had had influenza, but no venereal infection, in all of whom there was functional sterility. There were sperms present, but perfectly non-motile. Where the woman is well, and the trouble lies with the man, it is a difficult problem. I have sent these individuals to genito-urinary specialists for treatment with little result. Sometimes an internist may help by improving the general condition of health.

It is said that if these individuals live out of doors for several months, they may recover, and instances have been reported of recovery.

Dr. Joseph L. Baer: I venture to make two concrete assertions: First, that in Chicago today probably the overwhelming majority of all married women is using some form of prevention of conception by a single or a combination of contraceptive methods. When they fail, they drift in very considerable numbers to the professional abortionists; and second, there is on record in Chicago today a list of some four hundred physicians and midwives known to be doing criminal abortions. Women of the well-to-do and middle classes have the advantage of scientific instruction in prevention and employ the services of the so-called better abortionists, whereas women of the destitute strata are confronted with the same predicament, are poorly informed as to prevention and have access only to abortionists whose intervention often means death. There is no doubt that we should terminate pregnancy in a well-standardized list of conditions mentioned by Dr. Holmes. Yet we look on while abortions are being reported with increasing frequency in the newspapers, many of them leading to death more surely than the list of diseases for which we not only terminate pregnancy, but do not hesitate to instruct these women in the prevention of conception.

I feel quite differently than does Dr. Davis as to the possibility of functional sterility brought about by the use of proper contraceptive methods. Absolute continence, while it is conceivable, is hardly practicable. The sex instinct is next to the hunger instinct the strongest with which the human race is endowed. Continence, except at certain times a month, is a failure in the prevention of conception, as is the method employed by the great mass of the poor, the so-called withdrawal method, since the husband cannot control his seminal emission completely. Besides, there is no doubt among students of sex psychology that this particular practice, which is so widespread, is directly harmful to both partners. I believe that mechanical devices applied to the cervix are harmful. The so-called occlusion pessary with a circular ring, with rubber hood, which shuts off the external os, and which is left in position weeks at a time, is a source of direct infection to the cervical canal, such as a staphylococcus infection, which can lead to an ascending infection of the genitalia, involving the tubes, and possibly likewise involving the husband, he acquiring a non-specific urethral infection.

I believe there are safe and harmless methods of contraception, and that birth control should better be known as the regulation of conception, and the regulation of it in two directions: first, the limitation of conception among the destitute, the debilitated and the defectives, and the encouragement of conception among all those families that are qualified to raise more than one or two children, to which the average American family is dwindling. It is known on the continent of Europe as the American family, the two child family.

I think the members of this society should consider seriously whether it is not our mission, after we have reached a more or less unanimous conclusion, to take the lead in educating the public.

Among the poor at the Michael Reese Dispensary we have met this problem and have solved it in the following way: For a number of years the clinic nurse taught methods of prevention to women with increasing families. In recent times, after the social service branch of our work became established, we had relied on the social service workers to select the cases in which limitation should be taught, and these wives and husbands are brought to us for instruction.

Dr. Charles B. Reed: I am stimulated by the remarks made by Dr. Yarros to report the case of a woman who had been running a temperature of 103 to 104 for 3 or 4 days. In her case a diagnosis of influenza was made. This was last spring. I saw her in consultation and on examination I found a very tender cervix. There was a mass which could be felt in the pelvis. It was learned that a pessary had been in place 10 days. The woman had been married 4 months. She was removed to the hospital. We made some blood tests, and found the blood filled with streptococci. I think this case very clearly illustrates the danger of the use of contraceptive pessaries.

Dr. Carey Culbertson: I think the great difficulty in discussing any sociologic questions, such as the regulation of conception and the modification of birth control is that as human beings we are not wise enough to solve such a problem for the human race. As long as there are so many people who cannot be taught asepsis, we cannot avoid the morbidity resulting from contraception. Each one may be able to solve such a problem for himself but it is quite another thing to do this for another. In Dr. Davis' paper the influence of abortion in the production of infection is a point which should be emphasized. We know that in a large majority of cases conditions are neglected willfully or through ignorance by the patients. They go a number of days or 2 weeks with irregular bleeding, with portions of the gestation sac remaining in the uterus, and such a condition is very often followed by low-grade infection sufficient to produce the so-called catarrhal inflammatory reactions in the tubes with resultant occlusion.

Dr. Davis (closing): My interest in the so-called "birth control movement" began about 8 years ago when Dr. Blount and Yarros expressed their views at a medical meeting in Oak Park. Since then I have followed rather closely the possibilities for good or harm in the use of contraceptives and have come to the conclusions stated in the paper.

The term "birth control" is very misleading. It rarely happens that people can have a baby according to schedule. Nor can I agree with Dr. Yarros in the effectiveness of preventive methods even in the hands of highly intelligent people unless there is a potential sterility. We must consider abortion as a logical part of the birth control movement since a large part of criminal abortions are performed after the failure of contraceptives or what people thought safe measures.

Dr. Holmes has quite properly qualified my statement regarding the deposit of semen in the vault of the vagina. However, the exceptions are rare.

Dr. Danforth's question regarding "weak spermatozoa" brings up an interesting problem. It is a case of determining and if possible correcting the cause. In several cases studied it was due to excessive intercourse. I recall a patient seen with Dr. Culbertson who stated she and her husband were so anxious for children that they had intercourse at least twice every night. Some men may be potentially sterile from overwork, sedentary habits, etc. Absolute restriction of intercourse with an increase of physical exercise is of great value. Gland therapy may be of value in some cases. Dr. Danforth misunderstood my statement regarding uterine displacements; I agree with him.

Could Dr. Baer check up on all the cases given advice regarding contraceptive methods I am certain he would find that a goodly number had become pregnant while using contraceptives. If there are economic reasons why young people can not consider pregnancy it is better to postpone marriage than resort to contraceptives. As physicians we should give our patients to understand that when a pregnancy occurs, they must accept it rather than rush to the abortionist as so many do today.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS ON SURGERY

THERE is in these two small volumes[1] an old English flavor, so insinuating and pervasive, that one is prompted to exclaim, "Ods bodikins! A jolly brace of books." As a matter of fact, however, notice is paid to them in this review department, not because of their flavor but rather because we feel that the reading of them will furnish to any physician of appreciation, a real joy. They are not medical history in the conventional, dry-as-dust sense; rather do they give a vivid pen picture of medicine and surgery in England during the 15th century, as expounded by the master, John Arderne, and in the 17th century by that leader of English medicine, Thomas Sydenham.

The Sydenham volume is done by Dr. John D. Comrie of the University of Edinburgh, who contributes a short, thirty-page biography, with an appended, very full bibliography of Sydenham's life and works, followed by about one hundred pages of abstracts from the selected writings of Sydenham. These abstracts embrace about one-third of all of Sydenham's writings, and they are presented with that fine sense of discrimination that characterizes so much of the literary work of the English clinicians. When one has finished reading these abstracts, he has a most satisfactorily comprehensive idea of Sydenham's views on gout, epidemic diseases up to 1679, venereal disease, hysterical affections, small pox and St. Vitus dance.

Sir D'Arcy Power has handled his material in totally different fashion. In a short preface, he furnishes what little is known concerning Master John Arderne, surgeon of the 14th century. He shows wherein and why he was a practical surgeon, and reproduces an attractively charming colored print picture of old master John copied from a 15th century manuscript. All this is done within the compass of a dozen pages, after which there follows a literal translation (Master John wrote in Latin) of Arderne's manuscript—a scroll 17 feet long, by 15 inches wide, made up of twelve skins of vellum, sewed together. The manuscript is written in three columns, and is abundantly illustrated by colored pictures, quaint, artistic, and some of them humorous. D'Arcy Power has reproduced much of the manuscript, in thirteen full-sized plates, and has further enlivened his translation by explanatory foot notes.

Personally, I wouldn't barter the pleasure of having read Sydenham's "Gout" for the knowledge gained from a half dozen of our best modern textbooks, and I'd rather own old Master John, than to be the possessor of the rarest old rug from Araby.

One is struck by the childlike, utterly primitive thought of Arderne as contrasted with the strikingly logical reasoning of Sydenham (after all, however, the years of 1600 aren't so far back of us), and yet Arderne handles the subject of fistula-in-ano in very up-to-date fashion, whereas Sydenham exploits the "methodus medendi morbos per accubitum junioris," which is none other than a recommendation to cure great debility in old folks by putting young and vigorous persons in bed with them. He cites a cure that he wrought in the instance of a very sick old lady, by putting a 13-year-old girl "close to her breast."

If it were not that our cherished Anglo-Saxon culture teaches us repression, we might constitute ourself a cheer leader, and with appropriate gestures, shout: "Now, fellows, all together—John Arderne and Thomas Sydenham!" M. G. SEELIG.

THIS monograph[2] is one of that small group of clearly and concisely written books which stand apart by themselves. From a practical viewpoint, its subject matter thoroughly covers the surgery of the peripheral nerves and the book should be of material aid to the general surgeon called upon to deal with an occasional case of peripheral nerve injury.

The anatomy of the peripheral nerves, rather briefly considered, to be sure; the diagnosis of nerve lesions; the indications for operative interference; the type of operation to be chosen; prognosis and after-treatment constitute the first part of the volume. The second portion of the theme takes up in detail the surgical anatomy and methods of exposure of each of the peripheral nerves most commonly exposed to injury. In addition, a short discussion of the various methods of effecting union when end-to-end apposition cannot be obtained is given. Part three considers in detail the various tendon transplantations which may be used in the event of failure to obtain functional nerve regeneration.

The presence of supplementary movements in the muscles of both extremities is a point the impor-

tance of which cannot be overemphasized from the standpoint of diagnosis of nerve lesions. The authors very carefully describe the fixation of neighboring joints and the transposition of the nerve trunks from their normal bed to more favorable locations in efforts to obtain an end-to-end anastamosis.

Loyal E. Davis.

IN this monograph the authors[1] have considered all of the anatomical lesions, congenital or acquired, inflammatory or non-inflammatory which frequently are present about the cæcum and proximal colon. While many of these conditions may be present in a quiescent stage for a considerable period of time, they closely resemble certain valvular cardiac lesions in a stage of compensation. At any given moment the equilibrium may become broken and clinical symptoms become appreciable.

Pain in the right lower abdominal quadrant does not always justify casting suspicions upon the appendix which eventually lead to its removal. Other visceral lesions existing alone or associated with appendiceal inflammation may provoke similar and persistent symptoms. Patients complaining of right lower abdominal pain may be classified as belonging to one of three groups. A proportion of patients may be classed as suffering from chronic or subacute appendicitis and are unmistakably cured by an appendectomy. A certain number of others suffer from visceral or perivisceral lesions other than the appendix. In such cases, an appendectomy fails to restore the normal physiological function. To the last group belong those who have an inflammatory lesion of the appendix in conjunction with lesions elsewhere in the vicinity of the cæcum either of a developmental or acquired character. Appendectomy under these conditions must be accompanied by further operative work.

Among the extra-appendiceal lesions considered which confuse the picture are Jackson's membrane, abnormally mobile cæcum, total ptosis of the cæcum and ascending colon, ptosis and angulation of the transverse colon, cholecystitis, salpingitis, simple spasm of the ileum, and ileocæcal tuberculosis. Case examples of each of these types of lesion are included in the text. The volume deals quite thoroughly with the anatomy, embryology, recognition, differential diagnosis, and treatment of these lesions giving rise to gastro-intestinal tract symptoms resembling appendicitis. The theme is illustrative of the present trend toward surgical restoration of physiological function.

Loyal E. Davis.

WHILE the subject of fractures is world old, it still arises perennially, both in society discussions and as the output of the interested author via the medical publisher. This recent second issue[2] of a text on fractures of the extremities has been considerably enlarged and now contains over 600 pages with more than 150 new illustrations.

The author claims a desire to apply fracture lessons of the world war to our treatment of civil fractures, with an effort to avoid confusing the reader by too many details. An opening page devoted to the diagnosis of fracture is followed by a general exposition on treatment. Rules for X-ray examination are given along with indications for massage, electricity, and the use of anæsthesia. We are gratified to note an acknowledgment of worth of the Thomas splint, the use of which is advocated and the presence of which is called desirable in the armamentarium of every physician.

The text then takes up extremity fractures, starting with the clavicle and scapula; arm, forearm, wrist, hand, thigh, patella, leg, and foot follow. Couteaud's position for clavicular fracture, though well-illustrated, has not enough stress laid on its efficiency. The author still clings to non-operative treatment of fracture of the patella. His discussion of carpal fractures seems incomplete, inasmuch as his countrymen have done such clever research in this connection.

Plaster-of-Paris splints and encasements seem to express Judet's idea of sound basic treatment, and although continuous traction is described, most of the illustrations are confined to old-fashioned plaster treatment. Some of the apparatus pictured seems impossible of successful application; at least its maintenance until bone healing was ended would be impractical. Three very short chapters on callus formation, tetanus and gas gangrene terminate the volume.

In general one is struck by the terseness of the text, its specific information and the good classification of the injuries of each bone. Much attention is paid to the fractures of childhood, information about which is too frequently lacking in textbooks. There is a strange mixture of illustrations, varying from excellent halftones to crude line drawings. It is perhaps to be regretted in a subject so universal as fractures that with the exception of a few German references the author has not availed himself of the literature of countries other than his own.

Kellogg Speed.

THIS book[3] is essentially a record of personal experience in 31 cases of abscess of the brain. In addition, the author has compiled and analyzed the post-mortem records of 125 cases of cerebellar and 145 cases of frontal lobe abscess. From this material the treatment of brain abscess has been considered upon the basis of the existing surgical pathology.

Depending upon the mode of entry into the brain of different pathological processes causing brain abscess, the terms "adjacent" or secondary and "intercurrent" or tertiary are used. Emphasis is placed upon the fact that from various foci, abscesses

[1] Les Exsudes Appendiculés. By Th. de Martel and Edouard Antoine. Paris: Masson et Cie, 1922.

[2] Traité des Fractures des Membres. Examen Clinique, Radiographie, Traitements Pratiques. By Dr. Henri Judet. 2d ed. Paris: L'Expansion Scientifique Française, 1922.

[3] Brain Abscess, Its Surgical Pathology and Operative Technique. By Wells P. Eagleton, M.D. New York: The Macmillan Company, 1922.

develop in definite locations and, given these pathological facts, the surgeon should plan his operation accordingly. The author believes it possible to diagnose the presence or absence of an abscess capsule by careful evaluation of the symptoms. The diagnosis of the location of the abscess is written from the standpoint of where the pathology should be with a given mode of entry rather than from the viewpoint of the presence or absence of neurological symptoms produced by the lesion.

The volume impresses one as representing the efforts of a conscientious surgeon to treat, scientifically and successfully, the pathology of brain abscess and to pass on his experiences, good or bad, that this aspect of cerebral surgery might progress.

LOYAL E. DAVIS.

THIS little book[1] consists essentially in a table giving the dosage and other data of value in various types amenable to X-ray treatment. It is very concise and should be of value to those doing deep X-ray therapy. A. B. K.

THE book[2] is evidently designed to meet the need of the post-graduate student of ophthalmology. It presents a clear and concise account of the regional anatomy of the orbit and eyeball with frequent references to the functional significance of the various parts. Here and there attention is called to the practical importance, for the ophthalmologist, of certain structural arrangements. On the whole, the book is well suited to meet the requirements of any one who is looking toward ophthalmology as a specialty.

The usefulness of the book could have been increased, however, if even more attention had been given to functional and practical considerations. The reader misses, for instance, any account of the filtration angle of the iris or any statement of the importance of the spaces of Fontana for the escape of fluid from the eyeball. The importance of the anastomosis between the anterior ciliary arteries and the greater arterial circle of the iris in the production of the circumcorneal injection in intraocular inflammation is not mentioned.

The anatomical facts are, on the whole, correctly presented, but occasionally the author slips on some technical point, as when he defines a synapse as the close approximation of the dendrons of one element with the dendrons or cell body of another element

S. W. RANSON.

THE advancement made in the past decade in surgery of the respiratory tract is exceedingly striking. One has but to glance over the pages of any textbook on general surgery to note that the proper procedure for the removal of a foreign body in the trachea or bronchi is tracheotomy and extraction. With the advent of the bronchoscope and its use in skillful hands, direct examination of the larynx, trachea, and bronchi becomes more frequent.

Following the extraction of foreign bodies from the trachea, and bronchi through the bronchoscope came a study of the bronchi, and extraction of foreign bodies deeply seated in the lung and even in the upper bronchi.

Probably no one man has done more not only to perfect the bronchoscope and its accessory instruments, but also to elaborate a sure and delicate technique for bronchoscopy, than Jackson. The author, in a comparatively small volume,[3] attempts in a rather unique way to give the reader a conception of this apparently very complicated and delicate procedure. He has further chosen to make his text appealing to the reader by having it prepared more or less by a reader. He describes the instrumentarium in some detail, then follows the discussion of the peculiar anatomy of the larynx, trachea and bronchi, not only from a strictly anatomical standpoint, but from a bronchoscopic standpoint. In succeeding chapters the technique of introducing the laryngoscope and bronchoscope and the œsophagoscope is described, the author laying special stress on the fact that when the instrument is carefully and properly introduced, there should be but a slight element of danger, but he very plainly points out that if the technique is not strictly adhered to, not only great harm but even fatality may result.

The chapter devoted to removal of foreign bodies is probably the most interesting in the entire text. It is such a revelation to be told that foreign bodies of practically every description that have entered the respiratory passages, lodged in the larynx, trachea, larger bronchi, or even smaller bronchi, can be removed with comparatively little danger in practically every instance, and one has but to go over the careful technique advocated by the author to feel certain that if one prepares himself sufficiently in this technique, these rather spectacular results can be accomplished.

It would appear to the reviewer that bronchoscopy and extraction of foreign bodies from the respiratory passages has found a far greater field of usefulness than has œsophagoscopy. It is very plain to see that foreign bodies can be removed from the œsophagus and lesions of the œsophagus may be studied through the œsophagoscope, but this condition arises infrequently as compared to the study of the respiratory passages, so much so that it is a great question as to whether the œsophagoscope or gastroscope will ever come into the extensive usage of the bronchoscope.

This volume, although comparatively brief, gives a very comprehensive review of the subject, and even to the professional man who never expects to attempt such a procedure, the book is invaluable. One has but to glance at the chapter on foreign bodies in the lung to realize the peculiar symptomat-

ology found in these cases. Many of them are confused with embolic lung abscesses and tuberculosis. The information gained in reading this volume will not only enlighten one as to what is possible in a case of foreign body in the lung, but will widen one's vision in many instances in diagnoses of lung conditions.

This book can be heartily recommended as a unique and very valuable addition to one's library.

JOHN A. WOLFER.

ONE is comparatively safe in stating that no condition in the realm of orthopedic surgery presents more difficulties in treatment than does scoliosis. The fact that its cause is still a matter of conjecture and that the progress of the deformity is so often unaffected by treatment, makes it no mean problem for the orthopedist.

At the present time there seems to be some diversity of opinion among surgeons, not only as to the principal factor in its etiology, but likewise in the treatment thereof. It is, therefore, of more than casual interest again to receive the opinion of such a student and observer as Lovett.[1] As the author states in the preface, this, the fourth edition, contains little new in the treatment, perhaps laying a little more stress on the mobilization of the deformed and rigid spine. It would appear to the casual observer and reader that certain factors are at work in scoliosis which have not as yet been brought to light, and that until these insidious forces or changes, which no doubt play at least a passive if not an active rôle in the causation of the disease, are discovered the final and more correct elements of treatment will be wanting.

It is interesting to note that the author at least has the force of his convictions, and has but little altered his views since the appearance of the last edition. In brief, he advocates in the treatment of true scoliosis, removal of the cause if possible, exercise and gymnastics to develop the muscles and mobilize the rigid spine, corrective jackets as a retention, and again, as progress is satisfactory, exercise and gymnastics further to develop muscles and prevent recurrence. During the entire interval, careful consideration is given to the general health of the patient. One cannot help but be impressed with the fact that the logic is correct, and until some new factor is discovered which leads us to change our views as to the causation of scoliosis, the treatment outlined by the author does appear to be the correct one.

JOHN A. WOLFER.

BLOOD transfusion has found its greatest exponents in America, and this procedure is used here far more commonly than in any other country. No doubt in many conditions it becomes a necessary life-saving measure, and since the procedure under these circumstances is so frequently an emergency operation, it behooves even the general practitioner to be more or less familiar with the technique, and to equip himself and his hospital or office with the necessary information and apparatus.

Probably no publication on this subject, at least none that the reviewer is familiar with, is so concise yet brief as is the little volume prepared by Keynes.[2] The author after a short and very interesting chapter on the history of blood transfusion at once enters the subject by giving briefly the indications and uses of blood transfusion. His remarks are definite, and in some instances issue might be taken, yet he clings to generally accepted ideas and does not allow his enthusiasm to lead him astray. The chapters on "Danger of Blood Transfusion" and "Physiology of Blood Groups" are very interesting and instructive, in spite of the fact that practically nothing new is incorporated. The generally accepted methods of blood transfusion are described in detail in the closing chapter.

We are hearing almost daily of reactions during and following a blood transfusion, where theoretically there should be no unfavorable reaction. This would indicate that the final word has not as yet been spoken on this subject, yet for the man who wishes to familiarize himself with this very necessary procedure without the rather laborious task of going over a very considerable literature, this little volume is certainly a valuable asset.

JOHN A. WOLFER.

[1] LATERAL CURVATURE OF THE SPINE AND ROUND SHOULDER. By Robert W. Lovett, M.D., Sc.D. 4th ed. Philadelphia: P. Blakiston & Sons Co., 1922.

[2] BLOOD TRANSFUSION. By Geoffrey Keynes, M.A., M.D. (Cantab.), F.R.C.S. (Eng.). London: Henry Frowde & Hodder & Stoughton, 1922.

AMERICAN COLLEGE OF SURGEONS

IOWA, SOUTH DAKOTA, MISSOURI, KANSAS, NEBRASKA, OKLAHOMA, TEXAS, NEW MEXICO, LOUISIANA, MISSISSIPPI, ARKANSAS, FLORIDA, GEORGIA, AND ALABAMA SECTIONAL MEETINGS OF THE CLINICAL CONGRESS

DURING the month of January, six sectional meetings of the Clinical Congress of American College of Surgeons were held in various parts of the United States. At these meetings fully 6,000 persons heard of the work of the College in regard to hospital standardization, better health, and scientific surgery. The Fellows of the various states included in the groups came together at clinics and other meetings for mutual benefit. Credentials committee meetings, always well attended, evidenced a strong determination to uphold the high standards of ethics and efficiency required by the College. An important point upon which great emphasis has been placed at all the sectional meetings is that the American College of Surgeons will not under any circumstances countenance the pernicious practice of splitting fees. Sound ethics and the best professional service are required.

IOWA AND SOUTH DAKOTA

THE meeting for Iowa and South Dakota was held at Council Bluffs on January 8 and 9. The local committee of arrangements, of which Dr. Donald Macrae was chairman, had arrangements well in hand. The hospital conference was held in the First Congregational Church at 2 p.m., January 8. There were at least 250 in attendance and hospital standardization and efficient management were discussed from every angle. At the meeting of the Fellows which immediately followed the hospital conference there were some 40 present. Here the organization and work of the College was outlined by the associate director and illustrated by means of slides. The executive committees for the states were elected.

The public meeting held in the Presbyterian Church was attended by approximately one thousand people. Dr. Macrae presided and the program was enthusiastically received. Musical numbers were rendered by the church choir and organist, to whom the appreciation of the College is due. In addition to talks by representatives of the College, the following addresses were delivered:

Experimental Medicine. Harry M. Richter, M.D., Professor of Surgery, Northwestern University Medical School, Chicago.

Some Facts about Cancer. Carl A. Hamann, M.D., Professor of Clinical Surgery, Western Reserve Medical School, Cleveland, Ohio.

The Public and the Surgeon. Dean Lewis, M.D., Professor of Surgery, Rush Medical College, Chicago.

The scientific session was held in the First Congressional Church. There were approximately 75 present. The following interesting program was carried out:

Surgical Aspect of Gall-Tract Diseases. Harry M. Richter, M.D., Chicago.

Hydrocephalus. William E. Sanders, M.D., Des Moines, Iowa.

Chordoma, with Report of a Case. Theodore F. Riggs, M.D., Pierre, South Dakota.

Cleft Lip and Its Surgical Correction. W. H. G. Logan, M.D., Chicago.

Osteomyelitis. Dean Lewis, M.D., Chicago.

Unusual Forms and Locations of Tumors. Carl A. Hamann, M.D., Cleveland, Ohio.

A series of interesting clinics was conducted at the local hospitals on both days of the meeting.

MISSOURI

THE second group meeting, for the Missouri Section, was held at St. Joseph, on January 12 and 13. The headquarters and registration rooms were at the Robidoux Hotel. The local committee, although working at some disadvantage, had arranged an excellent series of meetings and dry clinics. All the meetings were held in the ballroom of the hotel. At the hospital standardization meeting and round table conference there were 125 present and the discussion showed that a keen interest was being taken in the principles of standardization and hospital efficiency. At the meeting of the Fellows which immediately followed the hospital meeting, the Director General gave a short outline of the work of the College. At this

session the state committee was elected for the ensuing year.

The public meeting was attended by approximately 500 and there was a spirit of enthusiasm and earnestness shown throughout the program which was very commendable. The local committee, headed by Dr. Daniel Morton, deserves the greatest credit for its able management, its enthusiasm and attention to detail. At the public meeting the following addresses were given:

The Meaning of the American College of Surgeons to the Public. Franklin H. Martin, M.D., Director General, American College of Surgeons, Chicago.
Factors of Safety in Surgery. Major G. Seelig, M.D., Professor of Clinical Surgery, Washington University, St. Louis.
The Hospital Standardization Program of the American College of Surgeons. Malcolm T. MacEachern, A.M., M.D., President-elect, American Hospital Association.
Experimental Medicine. Harry M. Richter, M.D., Chicago.
Some Facts about Cancer. Carl A. Hamann, M.D., Cleveland, Ohio.
Better Hospitals. Rev. C. B. Moulinier, S.J., President, Catholic Hospital Association.
The Work of the Department of Experts of the Board of Hospitals and Homes of the Methodist Episcopal Church. C. S. Woods, M.D., Chairman, Department of Experts of the Hospitals and Homes of the Methodist Episcopal Church, Indianapolis.
Modern Public Health. Allen Craig, M.D., Associate Director, American College of Surgeons.

Scientific sessions were held in the forenoon of the two days of the meeting. The program shows the excellent type of papers presented.

Friday Session:
Factors Determining the Choice of an Operation in the Surgical Treatment of Glaucoma. W. H. Luedde, M.D., St. Louis.
Arthroplasty. (Motion Pictures.) Frank D. Dickson, M.D., Kansas City.
Surgical Aspects of Gall-Tract Diseases. Harry M. Richter, M.D., Chicago.
Non-Lithogenous Biliary Obstruction as a Factor in Cholecystitis. (Lantern Slides.) Major G. Seelig, M.D., St. Louis.
Saturday Session:
Some Problems in Rural Health Service and State Medicine. Frank G. Nifong, M.D., Columbia, Missouri.
Tumors of the Neck. Carl A. Hamann, M.D., Cleveland, Ohio.
Surgical Repair of Congenital and Acquired Deformities of the Face. (Lantern Slides.) Vilray P. Blair, M.D., St. Louis.
Upper Intestinal Tract Obstruction; Blood Studies and Indications for Treatment. T. G. Orr, M.D., Kansas City, Mo.

KANSAS, NEBRASKA, AND OKLAHOMA

THE third group meeting included the states of Kansas, Nebraska, and Oklahoma, and was held at Topeka, January 15 and 16. Clinics were conducted at the local hospitals. The preliminary arrangements and the carrying on of clinics here devolved largely upon two men, Drs. Stewart and Mills. The hospital conference was one of the best of its type during the month. There were at least 100 present and the enthusiasm was quite marked. The public meeting was attended by approximately 400, and in addition to talks by representatives of the College, the following addresses were given:

Experimental Medicine from a Surgical Standpoint. John Wesley Long, M.D., Emeritus Professor of Gynecology, Medical College of Virginia, Greensboro, North Carolina.
The Work of the Department of Experts of the Board of Hospitals and Homes of the Methodist Episcopal Church. C. S. Woods, M.D., Indianapolis.
Experimental Medicine. Harry M. Richter, M.D., Chicago.

At the annual meeting of Fellows of the College between 30 and 40 were present, and the members of the state committee were elected for the ensuing year.

About 80 attended the scientific session at which the following papers were presented:

Disabling Injuries of the Shoulder. A. R. Mitchell, M.D., Lincoln, Nebraska.
Fractures of the Upper Extremity. Ralph V. Smith, M.D., Tulsa, Okla.
Jejunal Ulcer Following Gastro-Enterostomy for Duodenal Ulcer, with Case Reports. H. L. Snyder, M.D., Winfield, Kansas.
Surgical Aspect of Gall-Tract Diseases. Harry M. Richter, M.D., Chicago.
The Value of Enterostomy in Intestinal Obstruction. John Wesley Long, M.D., Greensboro, North Carolina.
Pulmonary Tuberculosis in relation to Surgery. Allen Craig, M.D., Chicago.

TEXAS AND NEW MEXICO

THE fourth group meeting, for the states of Texas and New Mexico, was held at Temple, Texas, January 19 and 20. The arrangements were in charge of an energetic local committee, with Dr. Scott as chairman. There was a very marked enthusiasm and evidence of attention to detail. Apparently no effort had been spared to make the meeting successful. Clinics were held in the local hospitals and the scientific sessions and public meeting in the First Methodist Church. Approximately 250 attended the hospital conference. About 60 were present at the meeting of the Fellows at which the election of committees for the ensuing year took place.

At the public meeting there were present approximately 1700 people. It was one of the most enthusiastic meetings of this type which the College has had. The organist of the Church

very kindly provided music. Dr. Bacon Saunders presided. Dr. Craig, associate director of the College, outlined the work of the College in relation to public health problems, and Dr. MacEachern discussed the hospital standardization program of the College. Dr. Long spoke upon "Experimental Medicine from a Surgical Standpoint"; Dr. Robert Jolly of Houston, Texas, on "How You Can Help Your Hospital."

The scientific session was attended by approximately 125 and all the papers presented were well prepared and thoroughly discussed.

LOUISIANA, MISSISSIPPI, AND ARKANSAS

IN the fifth group meeting for the month of January, the states of Louisiana, Mississippi, and Arkansas were represented. The meeting was held in Shreveport, Louisiana, on January 22 and 23. Dr. Thomas Ragan and his committee very successfully cared for the local arrangements. The meetings were held at the Youree Hotel. Approximately 200 attended the hospital meeting and round table conference, and 35 the meeting of the Fellows, at which officers for the ensuing year were elected. Owing to the serious illness in his family, Dr. Malcolm T. MacEachern was unable to be at the meeting. His place on the program was very ably taken by Dr. F. P. Miller of El Paso, Texas, who gave two excellent discussions on hospital standardization and conducted the round table conference.

The public meeting held in the ballroom of the hotel was attended by some 500, and the enthusiasm of those present was an evidence of the interest of the people in the better health movement and in hospital standardization. At this meeting the program of the College was outlined by its representatives and other problems discussed by eminent surgeons. Forty were present at the scientific meeting held on the afternoon of the second day, at which papers were read.

FLORIDA, GEORGIA, AND ALABAMA

AT the sixth group meeting for January, Florida, Georgia, and Alabama were represented. This meeting was held in Jacksonville, Florida, January 29 and 30. The hospital conference and scientific meetings were conducted at the Seminole Hotel. Clinics and demonstrations were given at the local hospitals. The public meeting was attended by 1000 people. Music was provided by the organists of the Church and also by the harpist. These numbers were very much appreciated. Addresses were delivered by representatives of the College and other speakers as follows:

Some Facts About Cancer. Carl A. Hamann, M.D., Cleveland, Ohio.
Experimental Medicine from a Surgical Standpoint. John Wesley Long, M.D., Greensboro, North Carolina.
History of Anæsthesia and Anæsthetics. Stuart McGuire, M.D., President and Professor of Surgery, Medical College of Virginia, Richmond.
How You Can Aid Your Hospital. Robert Jolly, Superintendent, Baptist Hospital, Houston, Texas.

At the scientific session on the second day 120 were present and papers were presented as follows:

The Influence of Hæmorrhage on the Mortality in Gunshot Wounds and other Injuries of the Abdomen, with an Analysis of Sixty-Nine Cases. James M. Mason, M.D., Birmingham, Alabama.
The Ureter versus the Appendix in Right-Sided Abdominal Lesions. J. N. Baker, M.D., Montgomery, Alabama.
Teaching Obstetrics. Joseph Akerman, M.D., Augusta, Georgia.
Accidents Liable to Happen to Benign Tumors of the Ovaries. Thomas P. Waring, M.D., Savannah, Georgia.
The Value of Enterostomy in Intestinal Obstructions. John Wesley Long, M.D., Greensboro, North Carolina
Treatment of Certain Types of Goiter. Stuart McGuire, M.D., Richmond.
Unusual Forms and Locations of Tumors. Carl A. Hamann, M.D., Cleveland, Ohio.

The clinics conducted in the various hospitals were carefully arranged by the committee in charge and well carried out. The Jacksonville meeting was very successful and its success was due to the energetic efforts of Dr. Gerry R. Holden and his local committee.

As will be noted the usual plan of having the hospital conference on the afternoon of the first day, the public meeting at night, the scientific meeting on the second day, and clinics in the morning, has been carried out. Meetings of the Fellows were held following the hospital conference. At these meetings the organization and work of the College has been carefully gone over and illustrated by means of lantern slides. In this way every member has had an opportunity of knowing of the work being carried on at headquarters. Constructive suggestions have been invited and the various problems of the individual states discussed.

The program of hospital standardization and better health is now soundly established. Everywhere there has been favorable commendation in this regard from both the public and the press. One could not speak too highly of the support and enthusiastic co-operation received from the churches, women's clubs, rotary clubs, and the press. To all who have so ably assisted in these very successful meetings during the month of January the College extends grateful thanks.

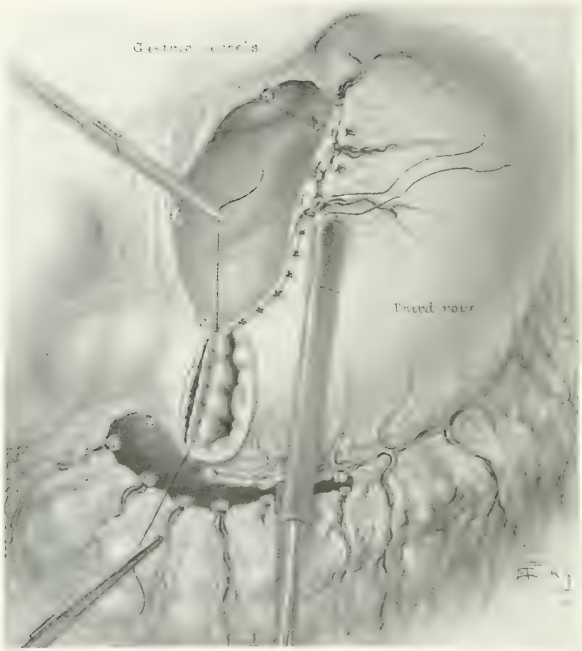


Fig. x. Third stage of Billroth I operation for resection of the stomach. Posterior mucomuscular suture uniting duodenum and stomach.

Radical Operations on the Stomach with Especial Reference to Maintenance of the Lesser Curvature. W. J. Mayo.

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RADICAL OPERATIONS ON THE STOMACH WITH ESPECIAL REFERENCE TO MOBILIZATION OF THE LESSER CURVATURE[1]

BY WILLIAM J. MAYO, M.D., F.A.C.S., ROCHESTER, MINNESOTA

THE foundation of modern gastric surgery was the exploratory incision. Sometimes, however, because of the nature of the disease the acid test of the knife was not considered justifiable until a stage in which the exploratory incision confirmed a bad prognosis in patients for whom earlier diagnosis would have been life-saving. To a degree this statement is true at the present day, although new diagnostic methods are resulting in much earlier diagnoses.

The newer knowledge which has come largely from the laboratory has been of such diagnostic importance in special fields that practitioners have become more or less dependent on laboratory tests for the development of many facts formerly derived without them. To a certain extent this dependence has led to the disuse and even to the abandonment of time-honored clinical methods which converted the practitioner's knowledge into wisdom, and consequently clinical acumen has suffered. I have been surprised to note the readiness with which high-grade young men, graduates from medical institutions which are models for our time, yield to the temptation of machine-made diagnoses. A few show an unfortunate willingness to start the patient off on a round of impersonal laboratory examinations before making thorough physical examinations and recording clinical findings. There is an apparent disregard of details of special importance to the clinician, an exaggeration of the importance of minor details, and an undue reliance on diagnostic pfennigs, which leave out of account the personal equation presented by the patient himself. The young medical graduate often shuns individual responsibility, and the majority no longer care for independent practice. The general practitioner feels that his day has passed.

In the Clinic, the diagnosis with such aid as the clinician himself can reasonably be expected to employ precedes all laboratory examinations, and this clinical diagnosis is recorded. All laboratory methods that appear to be necessary are then employed and used to check the clinical diagnosis. In this manner the competent clinician, by the use of eye, hand, and ear, aided by the various scopes, speculæ, stomach tube, and so forth, will make accurate diagnoses in from 80 to 85 per cent of cases, on an average. Checking by laboratory methods will modify clinical diagnoses by additional data in from about 10 to 15 per cent. If a machine diagnosis is made first and supplemented by a clinical diagnosis the accuracy in end-result will be greatly reduced.

Among all the additions to diagnostic resources that have been made in this generation, the roentgenograph is of first importance. The sense of sight in this field has brought order out of confusion and separated facts from fancies. We are indebted to the

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roentgenographer for a great extension of gastric surgery. It must be remembered, however, that the roentgenograph is not a picture of the object itself but a picture of its shadow. Carman has repeatedly called attention to the fact that the roentgenographic examination must be correlated with the clinical examination in order to attain its greatest usefulness. The roentgenograph, in the hands of experts, will insure correct diagnoses in from 90 to 95 per cent of cases of gastric lesions. While the roentgenographer is able to determine that a lesion does, or does not exist in the stomach, he is unable, in a very high percentage of cases, to determine the extent of a carcinomatous process in the glands or the tissue outside the stomach. That which to him may appear to be operable may prove, on exploration, to be inoperable, and that which appears to him inoperable, on exploration may prove to be the contrary.

Too often the diagnostician throws the entire diagnostic burden on the roentgenograph instead of using it as an aid to and an extension of the clinical examination of the patient. In many instances, huge lesions of the stomach are considered, roentgenographically, to be imoperable. The patients, however, are in such good condition that clinicians are led to advise exploration, which may disclose a large tumor of the greater curvature of the stomach which is operable and curable. Movability of the growth may be more important than its extent. The patient's good general condition, suggesting adequate resistance, will lead the competent clinician to advise an exploration in a doubtful case, whereas a poor condition will incline him to the opposite opinion. I dwell somewhat on the importance of the general physical condition of the patient with relation to cancer of the stomach because of experiences which have shown that the roentgenographer and the clinician must work out these problems together in order to secure the best results.

INDICATIONS FOR RADICAL OPERATIONS ON THE STOMACH

Radical operations for cancer of the stomach have attracted the attention of surgeons for 40 years, and for the last 10 years have been resorted to with increasing frequency in cases of benign lesions of the stomach. The most experienced surgeons incline more and more to some form of partial gastrectomy in certain types of ulcer of the stomach and duodenum, while the more radical group are applying the operation to practically all ulcers of the stomach and duodenum, and claim much improvement in results.

Gastro-enterostomy will cure more than 90 per cent of duodenal ulcers, and the excellent pyloroplastic operation of Finney with excision of the ulcer will add at least 5 per cent to the successful surgical group. There remains, however, a small, but definite, group of duodenal ulcers with deep excavations which may cause severe hæmorrhages, in which gastro-enterostomy will fail to relieve the hæmorrhages and othere severe symptoms, and the pyloroplastic operation cannot well be applied. In such cases, at least, partial gastrectomy of some type is the operation of choice. The field for partial gastrectomy is much wider in cases of gastric ulcer than in cases of duodenal ulcer. Gastric ulcers are usually greater in extent. They often slowly perforate, forming excavations into the pancreas, and lead to the formation of extensive and crippling adhesions. Hæmorrhages from these deep excavations are not infrequent, and may prove fatal, and at best in the case of the larger ulcers a crippled, inefficient organ remains after excision of the ulcer with or without gastro-enterostomy. In the smaller gastric ulcers along the lesser curvature, which comprise about 75 per cent of ulcers of the stomach, the conservative cautery excision of Balfour with gastro-enterostomy has proved successful in at least 90 per cent of the cases to which it has been applied. For extensive ulcerations in the vicinity of the pylorus, the partial gastrectomy of Rodman (Billroth II) has held steady place in the esteem of the conservative surgeon. Judd has shown that gastric resection in continuity for the larger ulcers of the body of the stomach gives satisfactory results. The Billroth I and II, the Pólya, and the Balfour-Pólya methods of partial gastrectomy, all have their special

fields of usefulness. Each case must be treated on its merits, and the decision as to procedure in a given case cannot always be made until surgical exposure makes accurate examination of the lesion possible. In this equation, the general condition of the patient is important, and in many cases determines the final choice of method. Generally speaking, in cases of gastric and duodenal ulcers which relapse subsequent to conservative operation (gastro-enterostomy and so forth), partial gastrectomy is indicated. The advocate of any one type operation for all ulcers of the stomach and duodenum is basing his conclusions on a unique experience.

Following radical operations for cancer of the stomach, a 10 per cent mortality is, I believe, justifiable and gives a just operability. If I find that my mortality is running under 10 per cent, I extend the field of operability, accepting cases for operation that previously I had considered inoperable. This practice has resulted in remarkable success in certain cases. A mortality of 5 per cent following partial gastrectomy for ulcer of the stomach may, with difficulty, be justified, and yet if partial gastrectomy is applied only to cases of more advanced and extensive ulceration and cases in which relief has not been obtained subsequent to previous operations, the mortality, according to my experience, will be approximately 4 per cent. If patients in good condition whose ulcers are small are operated on, this statistical mortality can readily be brought below 3 per cent. If the surgeon's pride in his statistical results of operative mortality leads him to apply the radical operation to the easy, safe cases and to use the less radical procedure on the dangerous type of case, which perhaps could be justified from the standpoint of risk, the mortality can be diluted to 2 per cent. If, in addition, the surgeon accepts for radical operation patients in good condition, with duodenal ulcers, there is no reason why the mortality following partial gastrectomy in skilled hands cannot be reduced to less than 2 per cent, making a relatively good showing as contrasted with gastro-enterostomy and pyloroplasty.

Admitting the force of the argument that partial gastrectomy permanently removes the ulcer-bearing and acid-controlling portion of the stomach, my personal experience has not yet led me to believe that partial gastrectomy has so wide an application to peptic ulcer. On several occasions I have made primary partial gastrectomies for chronic, moderate-sized ulcers of the lesser curvature and have not been satisfied when examination of the specimens showed definite, locally removable lesions of the stomach with a great amount of normal gastric tissue sacrificed unnecessarily.

MOBILIZATION OF THE LESSER CURVATURE OF THE STOMACH

I wish to call attention to the fact that the lesser curvature is the most important portion of the stomach. In the nature of things, the cardiac fixation of the stomach is seldom an obstacle to successful operation and we know how to liberate the pyloric end, so that for practical purposes in the great majority of radical gastric operations the lesser curvature is the key to the anatomic lock which interferes with the liberation of the stomach. The anterior and posterior surfaces of the stomach are normally free. The greater curvature, including the dome, can be readily mobilized. Surgeons who have had experience in the operation of splenectomy must have noticed that practically the entire stomach from the greater curvature to the œsophagus comes into the field of vision as the spleen is withdrawn from the abdomen. If one studies the musculature of the stomach as related to the vascular and lymphatic connections of the lesser curvature, it is apparent that the bands which hold and fix this portion of the stomach can readily be seen at operation and divided. The success of the procedure depends on early ligation of the gastric artery as close as necessary to the cœliac axis, depending on the location of the growth in the stomach (Fig. 1). After separating the gastrohepatic omentum from the under surface of the liver, the distal end of the gastric artery is held taut and the artery, glands, fat, and the unyielding structures are dissected from the lesser curvature toward the pylorus, the lateral vessels being caught and tied in succession as the holding bands are cut. The lesser curvature elongates

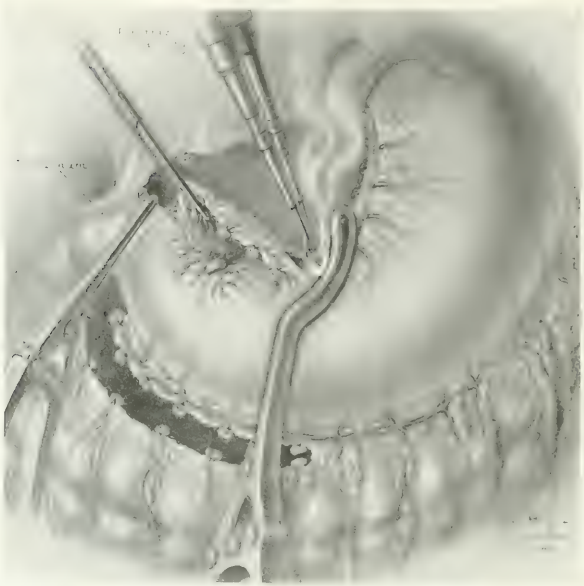

Fig. 1. First stage of Billroth operation for resection of the stomach.

remarkably, and in favorable cases snipping fibers here and there will permit the œsophagus to be drawn into view (Figs. 1 and 2) so that total gastrectomy can be performed if desired.

Mobilization of the stomach by attack on the attachments of the lesser curvature is extremely useful in operating on diverticula which are sometimes found at the œsophageal-gastric juncture, and on certain ulcers of the stomach, especially those high on the lesser curvature and posterior wall, but its greatest advantage is realized in partial gastrectomies for carcinoma. In the Clinic, following the removal of the malignant portion of the stomach we are more and more inclined in favorable cases to restore the lumen by anastomosing the end of the duodenum to the narrowed end of the stomach after the Billroth I method. This operation should not be forced. If it cannot be done easily, one of the other methods of gastrectomy should be applied. Narrowing of the stomach may be accomplished on the lesser curvature, by dissecting out the necessary portion of the lesser curvature, and suturing behind as the tissues are divided in front. Otherwise there will be difficulty in grasping and suturing the divided margins of the gastric wall as they retract. The Payr stomach clamp may be advantageously modified to aid in this manœuvre (Fig. 2). The blood vessels are caught and tied as they are cut. In this manner the necessary amount of the lesser curvature is dissected out. Experience has shown that the lesser curvature of the stomach is most vulnerable to the extension of carcinoma. Dissection of the lesser curvature at a higher point than one would ordinarily amputate is a protection against failure to eradicate the disease, as it removes the lymphatics most extensively.

METHODS OF RADICAL OPERATION

Experience with complete gastrectomies has not been sufficient to determine whether the

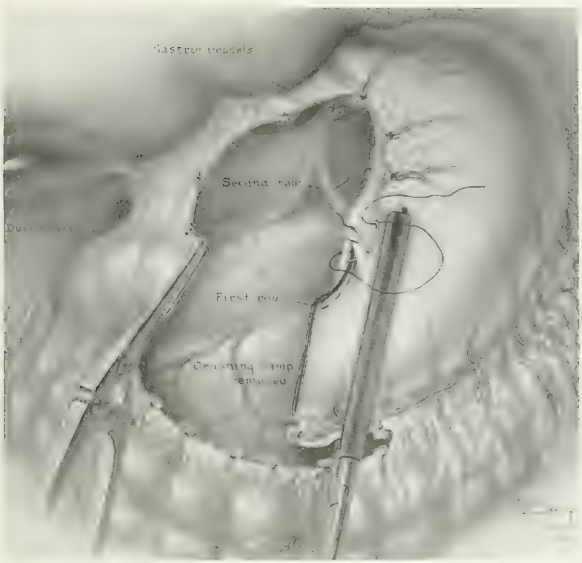

Fig. 2. Second stage of Billroth I operation for resection of the stomach.

resultant additional percentage of cures would be greater than the increased mortality would justify. If total gastrectomy is performed, I have found that the anastomosis of the jejunum to the œsophagus is best effected by the technique of Moynihan, beginning the union posteriorly by peritoneal-muscular sutures as the stomach is gradually cut free from the œsophagus. In this manner in a small number of cases I have been able to remove the stomach with less difficulty than might be expected. My own experience with complete gastrectomy has given me only one five-year cure. This patient is able to work and support his family, and by taking frequent meals is fairly well nourished, but he has a very peculiar pallor, at first glance appearing much like the pallor of pernicious anæmia. This peculiar type of anæmia has become apparent in our patients who have recovered from primary total gastrectomy. It is evident that the stomach has some immediate relation to the health of the red blood cell, and holds this property in common with the proximal end of the colon.

The Billroth II method of partial gastrectomy, closing both the end of the duodenum and the stomach, and performing a separate gastro-enterostomy has an established position in gastric surgery. As a method of partial gastrectomy subsequent to a gastro-enterostomy and in the two-stage operation in which the gastro-enterostomy is made at the first stage and removal of the diseased portion of the stomach at a second stage some days later, it is without competitor.

Balfour's modification of the Pólya operation in which the side of the jejunum is anastomosed to the amputated end of the stomach, antecolic, instead of retrocolic as in the Pólya, enables the removal of large portions of the stomach with comparative ease. This method is the one of choice and one might say, of necessity, for the average case in which the greater part of the stomach must be removed because of the size and situation

of the growth. In the Pólya type of partial resection, end-to-side, stomach-to-jejunum posteriorly, Charles H. Mayo some years ago introduced a method of removing a larger amount of the gastric wall on the lesser curvature, stitching the defect down to a bottle neck, applying the side of the jejunum to the narrowed end of the stomach. This procedure, so far as the treatment of the lesser curvature is concerned, is essentially the method here described.

The Billroth I operation is again coming to the front, not only for cancers located in the pyloric end of the stomach, but also for many ulcers of the lesser curvature. Instead of removing an unnecessarily large area of the stomach as in the older forms of partial gastrectomy, it removes the disease, saves the normal stomach, and restores the gastro-intestinal canal by uniting the duodenum to the amputated end of the stomach. As cancer has much the same area of distribution as ulcer, and it has been shown by a number of investigators that the lateral extension of cancer of the stomach is not more than 3 centimeters from the visible portion of the growth, this operation also has a useful function in cancer of the lesser curvature. Surgeons of this generation have been very largely influenced by the experience of the master surgeon Billroth, and the prejudices of his time have extended to the present so that the whole force of surgical experience has been to avoid the reunion of the gastric stump to the duodenum. It will be remembered that Péan, the great French surgical technician, who was the first to remove the pyloric end of the stomach for cancer (1879), made a direct union, and his patient died. Rydigier, in 1880, performed the second operation of this type; his patient also died. Rydigier's case was planned deliberately, and while it ended in failure he should be given full credit for his original conception. Péan's case was an accident, the result of an operation started for another purpose, and the resection was forced by events. Billroth, in his first successful case in 1881, removed the pyloric end of the stomach and united the stomach, end-to-end, with the divided duodenum. The operation was successful, but the end of the stomach being so much larger than the end of the duodenum, he found it necessary to narrow the stomach along the lesser curvature by a set of sutures which ran at right angles to the anastomosis and where the longitudinal and circular sutures met, leakage so often occurred that the site was given the name of "the fatal suture angle." To obviate this defect Kocher closed the end of the stomach and anastomosed the end of the duodenum to the posterior wall of the stomach, a method which could be applied only to the most favorable type of case.

Conditions have changed greatly since Billroth's time. Surgeons now suture in various directions in other portions of the gastro-intestinal tract, and with success, other things being equal. For many years in the Clinic, the Billroth I operation has been performed in suitable cases, both for cancer and for ulcer, and increasing experience is extending its use. In certain persons the shape, position, and movability of the stomach together with its loose attachments have made it comparatively easy to remove the pyloric half and still directly anastomose the end of the gastric stump to the duodenum. If the end of the gastric stump is not more than twice the size of the end of the duodenum, the difference in caliber can be stitched out by placing two stitches on the gastric side to one on the duodenal side; it is surprising how smooth such an anastomosis will appear when completed (Fig. 3). If the end of the amputated stomach is more than twice the diameter of the duodenum, it is narrowed by the proper placing of reducing sutures on the lesser curvature.

Schoemaker was the first to free himself entirely from the Billroth prejudice. He recognized fully that the fatal suture angle did not occur under modern technique, and showed that the extensive removal of the lesser curvature of the stomach with sufficient of the pyloric end to accomplish the purpose of the operation would, in a considerable percentage of cases, enable direct union between the cut end of the stomach and the duodenum. Schoemaker has invented some special instruments which he uses with great skill; his excellent work in this connection is

most stimulating and suggestive. Experience in the Clinic in similar, but less carefully thought out, procedures has led us to accept the Billroth I operation as a primary procedure to be used on ulcers and carcinomata which are situated on the lesser curvature and pyloric end of the stomach in such a manner as to permit the application of the method. The value of the procedure has been shown particularly in the last 2 years, since we have been able properly to mobilize the lesser curvature of the stomach. After the application of the Billroth I method, there is a tendency for the stomach to drop to the left of the spine, its weight exerting an injurious strain on the suture line uniting the end of the duodenum to the gastric stump. This difficulty has been overcome in these cases and also in cases in which, following excision of gastric ulcers or a Finney pyloroplasty, there is tension due to the dropping of the stomach as a whole to the left of the spine. A point on the anterior wall of the stomach sufficiently far to the left is chosen, the stomach is drawn to the right and attached to the suspensory ligament of the liver by several catgut sutures in a manner to bring the entire anastomosis to the right of the spine (Fig. 4). There has been no suture leakage and gastroduodenal drainage is greatly improved. As a temporary measure, the procedure is a useful technical manœuvre in many operations on the stomach, when the weight of the stomach lying far to the left pulls the duodenum rather tightly across and to the left of the spine, and perhaps may be useful in certain congenital conditions which interfere with gastric function not because of the presence of ptosis but because of interference with gastroduodenal drainage.

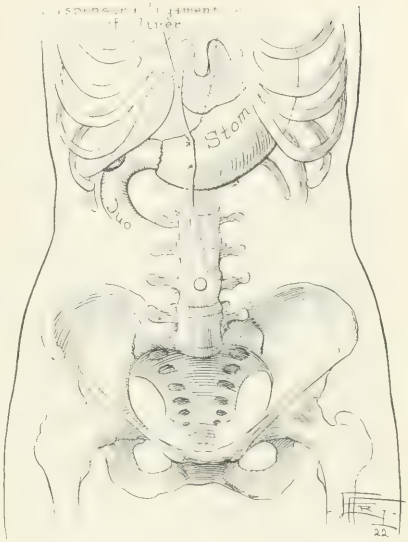

Fig. 4. Billroth I operation for resection of the stomach Gastroduodenal anastomosis drawn to the right side by two catgut sutures placed in the suspensory ligament of the liver and the stomach.

Proper mobilization of the lesser curvature of the stomach is the most important single step in radical operations on the stomach. The more favorable placing of incisions, the better mobilization of organs, and other technical manœuvres directly concerned with operations on the organs and viscera, not only in the abdomen but in the head and thorax, are increasing both the quality and the quantity of surgery by the reduction of mortality and the extension of operability.

THE SURGICAL TREATMENT OF ULCER OF THE STOMACH AND DUODENUM

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THE surgical treatment of ulcer of the stomach and duodenum may be said to be in a developmental state as far as the indications and the selection of the proper operative procedure are concerned. Those who favor the radical method blame gastro-enterostomy for their failures, while the adherents of the latter consider the radical method too dangerous and insist at the same time that a relapse cannot, with certainty, be prevented by this operation. I, myself, have for many years favored the radical method because I find it no more dangerous than gastro-enterostomy and because the end-results are far better. Gastro-enterostomy was the routine operation when I was assistant in the Hochenegg clinic. In my own experience in the last 7 years I have performed this only exceptionally, as, for instance, in the case of an acute perforation with peritonitis, or in certain cases of acute hæmorrhage in a duodenal ulcer. While up to 1914 I had performed 98 gastro-enterostomies and only 19 resections, the latter chiefly for suspected cancer, I have since performed only 40 gastro-enterostomies as against 427 resections.

An acute ulcer will heal spontaneously or by medicinal treatment and should be treated that way, the stomach ulcer as well as the duodenal. I operate upon the chronic ulcer when repeated medical treatment fails to cure it, when the recurring attacks with accompanying pain invalidate the patient. Individuals living at a great distance from a surgical clinic should be operated upon sooner than the people of a large city, because in case of perforation or of acute bleeding they cannot be transported without danger and without diminishing their chances of recovery. Early operation prevents perforation and acute hæmorrhage as well as the carcinomatous degeneration in ulcer of the stomach. I have never observed malignancy in a duodenal ulcer.

An acute perforation into the free abdominal cavity constitutes an absolute indication for operation. The success depends upon the interval which elapses between the perforation and the time of operating. Resection cannot be done in these cases except in the first few hours after perforation. Two such cases were operated upon successfully. Closure of the ulcer of the lesser curvature was performed four times; all 4 cases came late to operation, 34, 40 hours, and 7 days respectively. Of these, three died and one recovered. Of 19 cases of closure with an additional gastro-enterostomy 11 were cured and 8 died. All of these cases were operated upon from 12 to 24 hours after the perforation and exhibited signs of general peritonitis. One may do a successful operation as late as 24 hours after the perforation. Of 5 cases which came to operation 24 hours after, 4 recovered and only 1 died. The most essential elements of success in these apparently hopeless cases with diffuse peritonitis, cold extremities, and a small, thready pulse, are the use of local anæsthesia, cleansing of peritoneal cavity with normal salt solution and the after-treatment.

In acute hæmorrhage the early operation (24 to 48 hours after the hæmorrhage started) yields the best results. Among 20 early operations I had one death in five gastro-enterostomies. In 15, resection was the method and all of the cases recovered. Of 31 cases of late operations upon patients who were first treated medically from 4 to 14 days, and were sent to the operating table almost exsanguinated, we saved 22. The result in these cases depends upon the degree and the duration of anæmia with its consequent parenchymatous degeneration of the liver, the kidneys, and other organs. Great care must be exercised in giving morphine to these patients, both before and after the operation, as the ordinary doses may prove fatal. One must also be careful in the use of novocaine, substituting a one-fourth per cent solution for the usual one-half per cent. In gastric ulcer resection is possible even during hæmorrhage.

In the bleeding duodenal ulcer which cannot be resected, we ligate the pylorus, perform a posterior gastro-enterostomy and then press a large tampon upon the anterior duodenal wall and thus control the hæmorrhage by compression. This method, however, is applicable only in duodenal ulcers. Uncomplicated gastric ulcers, even those high up in the neighborhood of the cardia, can always be resected. Resection of a duodenal ulcer becomes impossible if the region of the papilla is involved.

Stomach resection has become a typical procedure with us and does not offer any difficulty except in certain cases of indurated ulcers. We begin with a hypodermic of morphine and then follow with local novocaine anæsthesia of the abdominal wall and the peritoneum. With this technique, the use of broad retractors is quite painless. We expose the space between the liver and the stomach and insert the needle above the cœliac trunk over the guiding finger with which we attempt to separate aorta and vena cava. We then inject upon the soft tissues overlying the twelfth vertebra, slightly to left, 50 to 70 cubic centimeters of a 0.5 per cent novocaine solution. This anæsthesia permits of a good deal of traction, so that even an indurated ulcer may be removed without pain. When, as the result of adhesions, the aorta and vena cava cannot be separated, splanchnic anæsthesia must be abandoned and the injection of the lesser omentum along the course of the two gastric arteries as well as of the base of the mesocolon along the right and the left gastro-epiploic arteries must be substituted.

The stomach and the duodenum are now carefully examined for the seat of the ulcer, if necessary with the finger in the stomach. Adhesions to the gall bladder are separated and in the case of stones or infection, cholecystectomy is performed. If we find an ulcer on the anterior wall of the duodenum, we must carefully examine the duodenum and the pancreas for the existence of another ulcer on the posterior wall. These not infrequently penetrate into the pancreas itself. We orient ourselves as to the extent of the ulceration, even if it be necessary to mobilize the duodenum by incising the peritoneum laterally until the region of the papilla is exposed. The choledochus must be followed from the junction with the cystic duct to the papilla to make sure that it can be isolated from the ulcer.

The technique of the resection is as follows: We find the first portion of the jejunum through a slit in the mesocolon which is made in a radial direction from the base to the arcade nearer the left side. Through this slit we draw up the first part of the jejunum. Next we separate the duodenum from the pancreas. In the case of a penetrating ulcer, the borders are separated and the base of the ulcer is left behind. We ligate the duodenum, invert the ligated part, and cover it with the remnants of the hepatoduodenal and the hepatocolic ligaments. The line of resection does not run vertically to the stomach but parallel to the median line of the body. The upper part of the resected stomach is closed by three rows of suture, the lower is temporarily clamped. We now suture the left side of the split mesocolon between jejunum and stomach about 10 centimeters long, the afferent part of the jejunum running toward the upper part, the efferent on the large curvature, the anastomosis itself lying in the median line. The aperture in the split mesocolon is sutured to the stomach. In this manner the anastomosis lies below the mesocolon. In an ulcer penetrating the pancreas, and the bed of which has to be left behind, we have to use drainage if the area cannot be peritonealized.

In gastric ulcer the resection of the duodenum is much easier, while in cardiac ulcers it may be very difficult. If the ulceration extends into the œsophagus, the resection should not be performed, because a fistula is certain to occur. I have performed the square median resection of the stomach nine times but have abandoned it in the last 8 years because the hyperacidity remained unaltered. I prefer to resect the pylorus and the antrum in gastric ulcers. The leaving behind of an ulcerated pancreas is without an consequence, but drainage becomes necessary. However, through this leaving of the base of the ulcer, even the largest and most extensive ones can be resected. Insufficiency of the stump of the duodenum was never observed. In an ulcer of the duodenum which cannot be removed on account of anatomical difficulties, I no longer

perform a gastro-enterostomy or an unilateral exclusion after Eiselsberg. The latter procedure, while permitting the healing of the ulcer, carries with it the danger of formation of peptic ulcer of the jejunum (Haberer had 25 per cent peptic ulcers with this method).

My method is to resect a large portion of the stomach. I recommended the method in 1918 in the *Zentralblatt fuer Chirurgie*, as a result of my observations at that time and applied it in all cases where the resection of the ulcer was technically impossible. The technique is as follows: The stomach is resected 2 to 3 fingers' width beyond the pylorus, the peripheral end is closed by a double row of sutures and covered by the remnants of the gastrocolic ligament. Of the stomach two-thirds or three-fourths (15 centimeters of the small, 25 centimeters of the large curvature) is resected, the cut is placed obliquely to the axis of the stomach, and a typical end-to-side anastomosis is performed. If the ulcer does not reach the pylorus, one may remove the pylorus, cut the duodenum close to it and suture it. The typical removal of the pylorus for the sake of exclusion is dangerous for the safety of the closure of the duodenum. I have formerly performed a gastrectomy up to the anastomosis in cases where a previous gastro-enterostomy had been done but where, on account of persistent symptoms, another operation was indicated. The results, however, were poor. I now resect the anastomosis and make a new side-to-end anastomosis higher up.

The technique of the anastomosis is that which Hofmeister described and which is known as Billroth II. Billroth I, the direct union of stomach and duodenum which Haberer calls the ideal method, I performed in gastric ulcers where it was easy to do so, but very seldom have I done it in duodenal ulcers. The end-results, however, were much poorer than with the ordinary Billroth II. I observed two positive relapses among 52 cases. The great discomfort present was evidently due to new adhesions of the duodenum.

The mortality in resections is not larger than after gastro-enterostomy in most clinics. Not including the cases of acute hæmorrhage, in which the result depends upon the amount of blood lost, I have now in 407 cases a mortality of 4.4 per cent, of which the greater portion was due to insufficient asepsis. Since 1919 I have operated upon 296 cases with a mortality of 2.3 per cent. In these I include 207 cases of particularly difficult resections (more than half of the stomach) with only 3.3 per cent mortality. In the last three and a half years I had, among 158 resections, only three deaths: one postoperative hæmorrhage in a case of liver cirrhosis; one hæmophilia and one peritonitis, which means a mortality of 1.8 per cent. I wish particularly to emphasize that no case died within the first few days of so-called shock or heart failure. Not a single case died of pneumonia, although I resected in every case when technically possible regardless of cachexia or lung complications such as emphysema, purulent bronchitis, or tuberculosis with cavities. I would emphasize particularly that 43 patients were between the ages of 66 and 76 years, and in spite of lung complications, all recovered and are still well.

These really splendid results I ascribe, first of all, to the use of novocaine in the place of general anæsthesia. Whenever surgeons say that local anæsthesia in ulcer is impossible it is more likely that the method has not been used properly. Formerly I injected only into the lesser omentum and into the base of the mesocolon and into the parietal peritoneum of the pancreas. With this method I was able to operate upon two-thirds of the cancer cases, 40 per cent of ulcer cases without a drop of ether, 36 per cent of cases in which 20 to 50 cubic centimeters of ether were given in 2 hours, so that one cannot call this an ether anæsthesia. Only in 24 per cent of the cases was ether given for some time.

With the splanchnic anæsthesia, which I used in 232 cases without a complication, I was able to operate upon 89 per cent of the cases without ether. In the rest of the cases a slight ether rausch was used, but as a rule the operation could be completed without it. Only in 2.1 per cent of the cases did the local anæsthesia fail. In these cases extensive adhesions in the retroperitoneal space prevented the diffusion of novocaine. The splanchnic anæsthesia, therefore, is the greatest advance in the surgery of the painful penetrating ulcer. My experience completely disproves

Gottstein's contention that lung complications cannot be prevented by local anæsthesia. The retention pneumonia can be prevented through an exact after-treatment, pulmonary exercises, and the coughing up of secretions at regular intervals. However, should pneumonia set in, the prognosis is much better because the heart has not been vitiated by an anæsthetic. While in other clinics pneumonias occurred after gastro-enterostomies upon selected cases, I have not lost a single case from pneumonia in my massive resections of the stomach. The end-results are good provided enough of the stomach has been removed. I have not had a peptic ulcer of the jejunum among my cases. Not all of the gastric cases were followed up; however, I am not aware of a single failure. The duodenal ulcers were carefully followed up so that at the present, after 2 years, I have 94 per cent of absolute cures. Only 6 per cent had slight discomfort and this was caused by ventral hernia, cholelithiasis, etc. Peptic ulcers or very severe symptoms were not observed.

The results are likewise favorable in the gastric resections for the purpose of exclusion in an inoperable ulcer; at any rate they are better than after gastro-enterostomy (Payr 62 per cent, Haberer 36 per cent good results). Ninety per cent of my cases are free from symptoms. Eight per cent have slight symptoms which are mainly referable to cholelithiasis, adhesions, etc. In one case only did I see a relapse. A large peptic jejunal ulcer developed which required a second operation. I had not removed enough stomach and a retrograde filling of the duodenum developed, and through this a hyperacidity which had to be combated by alkalies. In resection it is absolutely essential to remove two-thirds to three-fourths of the stomach, and through exact incision and anastomosis prevent retrograde filling of the stomach stumps.

In the gastro-enterostomy of the posterior type with a short loop, I have a mortality of 11.8 per cent in 144 cases. Excluding the cases operated upon for acute hæmorrhage, there remain 113 cases with 4.4 per cent mortality. The causes of death were: erosin in one; perforation, one; peritonitis, one; two cases of inanition. There was no pneumonia and the end-results did not differ from those of other clinics. They were, however, much poorer than those of resection.

Among 37 cases of gastro-enterostomy for duodenal ulcer, there were two cases of peptic jejunal ulcer. The rest of the patients must be careful in their diet to stay free from symptoms. The radical operation for peptic jejunal ulcer is one of the most difficult. This operation can likewise be performed under splanchnic anæsthesia. It consists in the resection of the duodenum and of a large portion of the stomach, including the anastomosis, followed by a new union of the jejunum and stomach. I did 12 such operations with splanchnic anæsthesia alone, in 9 cases ether had to be supplemented, in 9 cases mesenteric anæsthesia and ether were necessary. One case had a diffuse peritonitis, the result of perforation into the free peritoneal cavity, and one case was bloodless after erosin of the median colic artery. Both cases died. In the resections upon 28 uncomplicated cases, 27 recovered and only 1 case died. In this case the ulcer developing in the anastomosis penetrated deeply into the pancreas and was spread over the whole posterior wall. It was really inoperable because the stomach could hardly be closed. This formidable operation has lost a great deal of its danger through the use of local anæsthesia. However, to obtain satisfactory end-results, a great deal of the stomach must be removed; removal of pylorus and antrum as recommended by Schur and Lorenz is not sufficient.

I removed the pylorus and antrum and made a Y anastomosis in two brothers who suffered from peptic jejunal ulcer, after a gastro-enterostomy for hæmorrhages and pain. The symptoms persisted notwithstanding the use of alkalies and atropin. A year and a half ago a third operation was performed because of the severity of symptoms, and at this operation a large pancreas ulceration in the Y anastomosis was revealed. I resected the anastomosis and a large portion of the stomach, and since that time both are perfectly well and can eat everything. These two cases demonstrate in a striking manner the advantages of massive stomach resection.

MORTALITY IN SURGERY OF EXOPHTHALMIC GOITER

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THE results of the present-day surgical management of exophthalmic goiter compare favorably with those of any surgical procedure of equal magnitude. In the Mayo Clinic during the year 1922, 1,093 operations were performed for exophthalmic goiter with 11 deaths, a mortality of 1 per cent. These figures were computed from the surgical procedures on patients with exophthalmic goiter only, the diagnosis of which was based on the clinical history and findings and on the basal metabolic rate, and corroborated in every instance in which gland tissue was removed by the pathologist's diagnosis of diffuse parenchymatous hypertrophy of the thyroid gland. Unless the clinical diagnosis is accurately checked by the estimation of the basal metabolic rate and by the characteristic pathological findings in the gland a large loophole for error exists. A definite distinction must be made between exophthalmic goiter and other types of goiter if the facts are to be reached. If statistics are based on the various surgical procedures for goiter, only a vague idea can be obtained of the operative risk of patients with exophthalmic goiter, for the mortality rate will be diluted in direct ratio with the number of simple goiters included in the computation. Thus during the same period there were 663 thyroidectomies on 663 patients for adenomatous goiter without hyperthyroidism, with one death; a mortality rate of 0.15 per cent.

In the earlier days of thyroid surgery the relatively high mortality rate was an influential factor in the decision of many patients with exophthalmic goiter to seek means of cure other than surgery. Many of these finally came to surgery late in the course of the disease, when the operative risk was increased and when the prospect for complete cure was greatly diminished; thus a small vicious circle was created. But the knowledge of the benefits derived from surgery has gradually become more widely disseminated, and today a much larger proportion of patients with exophthalmic goiter seek surgery primarily, early in the course of the disease, when the risk is less and the prospect for complete cure is greatest.

The causes of death following operation on patients with exophthalmic goiter may be conveniently divided into three groups: (1) death as a direct result of the disease or the effects of the disease; (2) death as a direct result of an accident, and (3) death as the joint result of the disease and an accident.

GROUP 1

The rôle played by the disease itself as the direct cause of death following operation may be considered under two headings, acute exacerbation of hyperthyroidism or dysthyroidism induced by a normal operative procedure, and visceral degenerative changes incident to the long-continued hyperthyroidism.

Acute exacerbation of hyperthyroidism may be induced by the effects of the surgical procedure, by an intercurrent disease, trauma or shock, or it may be spontaneous at any time during the course of the disease.

The spontaneous crises of hyperthyroidism are sometimes observed while the patient is under treatment. One of the 11 deaths credited to surgery in the series of 1,093 operations performed at the Mayo Clinic in the year 1922, belongs in this group. A middle-aged woman (Case A399664), with moderately severe thyroid toxæmia, and a basal metabolic rate of +69, convalesced normally for 4 days following ligation of the left superior thyroid vessels. On the third and fourth days after ligation, her general condition was good and she was out of bed. It was noted, however, that she was more depressed than usual. On the fifth day her appetite was poor and she complained of pain in the upper abdomen. By the tenth day she was in a typical crisis of exophthalmic goiter, with much abdominal discomfort accompanied by nausea and vomiting. She became irrational on the twelfth day

and died on the fourteenth day after operation, from acute hyperthyroid crisis with high fever. Necropsy revealed a healed left cervical incision; hyperplasia and adenomata of the thyroid; persistent thymus (25 grams.); cardiac hypertrophy (475 grams.) and dilatation 2+ with fatty changes; pulmonary œdema and congestion; beginning arteriosclerosis of the kidneys with hypertrophy, and fatty changes in the liver.

Our means of combating the postoperative reaction of dysthyroidism, when once induced, are ineffectual, but within recent years many advances in preventive measures have been made. The occurrence of reactions, although thus greatly reduced in number and severity, must still be considered as only partially avoidable. The preventive measures divide themselves into the pre-operative preparation of the patients and the details of the surgical management. By means of preliminary treatment through the co-operative efforts of the internist, the laboratory and the surgeon, the condition of the patient in most instances can be so greatly improved that the danger of postoperative thyroid crisis is reduced to a minimum.

Between 30 and 40 per cent of the patients with exophthalmic goiter are in good condition on admission to the Clinic, and require only routine preliminary examination and treatment to prepare them for thyroidectomy. The condition of one-half of the remaining 60 to 70 per cent, who are not considered safe for operation on admission, can be so markedly improved in 10 to 14 days under medical management, consisting of rest, adequate diet and fluids, digitalis as required, and the judicious administration of iodides (Lugol's solution), that the patients become safe risks for primary thyroidectomy. For the remaining 30 to 40 per cent, preliminary surgical measures, such as ligations and injections, are necessary: (1) when there is doubt as to the possibility of an acute reaction in a moderately toxic patient following a major operation, a ligation is performed or an injection of boiling water is given as a tolerance test, and (2) when it is apparent that a primary thyroidectomy is almost certain to induce an acute reaction in a more toxic patient, the minor operative procedures are employed as therapeutic measures. Later, after a period of rest, in most instances the benefits derived therefrom are so marked, that the operation for the resection of the goiter can be undertaken with almost complete assurance of the absence of any postoperative reaction.

The residual effects on the organism of long-continued hyperthyroidism manifest themselves in visceral degenerative changes, especially affecting the heart, liver, kidney and muscles. These changes are often insidious in onset, but slowly progressive and, unfortunately, only partially remediable. As is to be expected, patients in this group form the largest part of the mortality list in the surgery of exophthalmic goiter. However, the added risk in this group is a justifiable one, and must be faced, for successful surgery restores to nearly complete health many of these otherwise hopeless invalids. While the relative proportion of patients with visceral changes admitted to the Clinic is still too large, fortunately this proportion is diminishing year by year, owing to the fact that the patient with exophthalmic goiter is coming to operation earlier in the course of the disease. Preparatory measures similar to those I have outlined are indicated, and sometimes much benefit can be derived. In many other instances little improvement can be gained short of the partial removal of the gland. In some instances the degenerative changes are so advanced that the patients will die while under treatment, before they can be prepared for thyroidectomy. In the series reported here, one patient, whose death is credited to surgery, may be included in this group:

Case (A398524), a woman, aged 38, was admitted to the Clinic July 19, 1922, with symptoms of intense hyperthyroidism of 5 months' duration. She was extremely emaciated, her weight having dropped from 122 to 94 pounds. There was cardiac decompensation with marked œdema of the legs and marked pulsation of the veins of the neck. The systolic blood pressure was 208, the diastolic 132. There were punctate, papulopustular lesions on the back, and the Wassermann reaction was strongly positive. The basal metabolic rate was +102. The pulse rate was 142 and thready in character. Dyspnœa and cyanosis were moderate. There were

occasional spells of vomiting. The patient was placed in bed and given digitalis. Her condition improved slightly and August 22, 2 cubic centimeters of boiling water was injected into the right lobe of the thyroid. No reaction followed, and August 29, 3 cubic centimeters of hot water was injected without incident. August 31 and September 5, division and ligation of the left and right superior thyroid vessels, respectively, was made, without any reaction. Her general condition at this time was considerably improved, her appetite was good, and she was able to sleep well at night. Her improvement continued until September 9, when respiration gradually increased in rate and it was noted that the abdomen was distending. The liver was enlarged to 10 centimeters below the costal margin. Œdema of the feet, ankles, and gluteal region was markedly progressive. September 11, there was evidence of fluid in the chest, and September 12, the right chest was aspirated with the removal of 900 cubic centimeters of clear, straw-colored fluid. Following this, there was some improvement in respiration, but slight jaundice developed and the patient complained of abdominal cramps which were accompanied by a slight diarrhœa. September 15, the fluid reaccumulated. The patient grew progressively worse and died September 24. Necropsy revealed exophthalmic goiter, acute hæmorrhagic glomerulonephritis, multiple, small, infected pulmonary infarcts, hypertrophy of the heart (375 grams.) and dilatation of the left ventricle.

GROUP 2

The accidents responsible for death following operation on the thyroid gland are similar to the accidents following other operations. They may be divided into those avoidable and unavoidable.

Haemorrhage. In the early surgery of goiter, hæmorrhage on the operating table was common, and often fatal. Today, while profuse hæmorrhage is sometimes encountered during the course of thyroidectomy for a very vascular and friable goiter, our means of controlling bleeding are so vastly improved, that this is practically never a direct cause of death. However, if excessive bleeding has occurred during the course of an operation in a bad risk case, it may prove a contributing factor in the cause of death. Owing to the vascularity of the thyroid and to the fact that the stump of the resected gland is movable on swallowing and coughing, postoperative hæmorrhage is not uncommon, but as its presence is usually manifested early by the development of pressure symptoms and a tumor in the neck, it can readily be detected and controlled before the loss of blood volume is sufficient to be alarming. Therefore, unless the surgeon is careless in recognizing the danger signals, or unless the bleeding is within the mediastinum, this complication is practically never the direct cause of death.

Obstructive dyspnœa. This complication in goiter surgery must be constantly borne in mind by the operator. It is always of serious importance, not infrequently is a contributing factor, and at times is the decisive factor in the death of the patient. Conservatively estimated, I believe that 90 per cent of all such deaths are avoidable, an opinion opposed to that formerly held, when the cause of practically all postoperative obstructive dyspnœa was credited to collapse of the trachea or to œdema of the glottis, apparently unavoidable complications. Instances of collapse of the trachea with serious dyspnœa, have been encountered during and after the removal of large goiters, but they are very uncommon. Similarly, it is rare to find postoperative œdema of the glottis of sufficient degree to produce serious dyspnœa. The most common cause of this very serious complication is paralysis of one or both of the vocal cords, as a result of either permanent or temporary injury of the recurrent laryngeal nerve. Other causes may be enumerated, such as partial occlusion of the trachea from pressure of forceps, or from substernal or retrotracheal adenoma, postoperative hæmorrhage and infection, and surgical rotation of the trachea.

Tetany. Theoretically, parathyroid tetany must always be included in the list of dangers associated with operations on the thyroid gland; but, practically, with the standardized operations of today, its incidence is so small and the severity of the attack is so mild, that its rôle can be considered only with those complications of lesser importance. In my experience this accident most often follows operation for recurrent goiter, when the second operation consists in a too liberal resection of the remaining lobe.

From 1917 to 1922, inclusive, there were in the Mayo Clinic more than 10,000 operations for the resections of the thyroid gland, and the records show the occurrence of symptoms

suggesting tetany in 35 cases. In 11 of these cases the symptoms consisted only of a transient sensation of slight numbness, or a painful twitching of the fingers and toes, and a reasonable doubt of the diagnosis existed at the time. In the other 24 cases, while the symptoms were more definite, with painful contractions or spasms, the tetany was of a transient nature and easily controlled by the administration of calcium. In no instance in this entire series has tetany been an associated complication in the operative mortality.

Pulmonary infection. This complication in patients with exophthalmic goiter is relatively common and is often an important, if not a decisive, factor in the death of the patient. Its occurrence is readily accounted for by the weakened and debilitated condition of the patient, a result of the disease. At necropsy pulmonary infection is noted in from 20 to 30 per cent of patients with exophthalmic goiter, but in many of these its presence can be explained as a terminal process. The complication cannot be strictly considered as avoidable, but its incidence can be materially reduced by care in the surgical procedures. The avoidance of prolonged general anæsthesia, of prolonged surgical trauma, and of injury to the recurrent laryngeal nerve is in this connection a principle of paramount importance.

Air embolism. While the number of deaths proved to be due to air embolism is very small, I am convinced that it is a danger in operations for goiter which every surgeon should fully appreciate. During the course of an operation for the removal of a goiter, when an unrecognized opening in a large vein has resulted from tearing or from the loosening of a clamp or ligature, conditions are ideal for the entrance of sufficient air into the circulation to produce death. On two occasions during the process of thyroidectomy for large goiters I have seen the sudden development of alarming symptoms of cyanosis, dyspnœa, loss of consciousness, and rapid, weak pulse follow the unrecognized loosening of a ligature around a large vein. In both instances the symptoms disappeared shortly after the immediate occlusion of the opening in the vessel. If facts were known, I believe that this complication would account for many of the "unexplained" goiter deaths that have occurred on the operating table, or a few hours later. To avoid this, the thyroid veins should be tied as they are divided, and at the conclusion of the operation before the wound is closed, the patient should be made to strain, as by coughing, in order to detect the presence of an insecurely tied vein.

Pulmonary embolism. The occlusion of a large branch of the pulmonary artery by a blood clot is an unavoidable tragedy which occurs in association with all major surgical operations, but fortunately, in operations for goiter its occurrence is uncommon. Thus, Heard, in reviewing the cases of pulmonary embolism in the Clinic, found that from 1912 to 1920 inclusive, there were 14,911 operations for resection of the thyroid, and 3 deaths from pulmonary embolism, or 1 in 4,970. During the same period there were 4,145 ligations with 1 case of pulmonary embolism.

Infections. Wound infections occur with about the same frequency as in other surgical cases of similar nature, and, fortunately, only in the exceptional case does it endanger the life of the patient. When a tracheotomy has been necessary after the removal of a large substernal or intrathoracic goiter, the consequent infection may invade the mediastinal structures and prove fatal.

Intercurrent diseases. Diabetes, influenza, erysipelas, thrombosis, and so forth, may be encountered, and their influence on the result of the operation will vary with the severity of the disease.

GROUP 3

Often death following operation may be caused by the disease and some exciting or contributing factor, other than the effects of a normal operative procedure. For instance, a patient with moderate toxæmia, who in all probability would survive an uncomplicated operation, may die if the operation or the convalescence is complicated by an accident, such as obstructive dyspnœa, hæmorrhage, or pneumonia, which in itself is not of sufficient magnitude to prove fatal. A postoperative accident may occur in the non-hyperthyroid patient and prove of only minor significance in the convalescence, whereas a similar com-

plication in the patient with exophthalmic goiter may be the decisive factor in the death of the patient. In cases of exophthalmic goiter the margin of safety is so small that any added tax on the organism may completely alter the operative result. Extreme care of details in the surgical management of patients with exophthalmic goiter is paramount.

MORTALITY

During the year from January 1, 1922, to December 31, 1922, 1,003 operations were performed on 633 patients with exophthalmic goiter. Eleven patients died, a mortality by case of 1.73 per cent, and by operation of 1.005 per cent.

	Cases	Mortality	Per cent
Thyroidectomies for exophthalmic goiter[1]	528	5	0.95
Ligations preliminary to thyroidectomy for exophthalmic goiter.	485	4	0.82
Hot water injections preliminary to thyroidectomy for exophthalmic goiter	82	1	1.21
Injections 0.5 novocaine preliminary to thyroidectomy for exophthalmic goiter	3	1	33.33

This includes all patients with exophthalmic goiter who died in the hospital following surgical procedures without regard to length of time or cause of death. None of the patients was transferred after operation to "medical service." As shown in the tabulation, 2 of the 11 patients who died had injections only. In the Clinic this procedure is used as a tolerance test if patients are desperately ill, and it is probable that one or both of these would have died as a result of the disease, irrespective of the injection. Two other patients, whose records are abstracted herein, died as a result of the disease. One man aged 68 years, with marked arteriosclerosis, died 9 days after ligation from thrombosis of the left femoral artery, with beginning gangrene of the foot. One patient died 50 days after thyroidectomy, as a result of an abscess in the

[illegible]

divide the operation into two stages.

spleen. One death 8 days after thyroidectomy was due to bilateral lobar pneumonia. One patient died 21 days after thyroidectomy, from bilateral bronchiectasis and multiple abscesses of the lung. The cause of death of the remaining 3 patients was hyperthyroidism and bronchopneumonia.

SUMMARY

The mortality rate following surgical procedures in patients with exophthalmic goiter has been reduced to 1.005 per cent in terms of operation and 1.73 per cent in terms of patients.

The estimation of the basal metabolic rate and the characteristic pathological findings of diffuse parenchymatous hypertrophy of the thyroid gland are essential checks on the clinical diagnosis of exophthalmic goiter.

Statistics based on goiter operations do not give a correct idea of the operative risk of patients with exophthalmic goiter, for the mortality rate will be diluted in direct ratio to the number of simple goiters (without hyperthyroidism) included in the computation.

In computing the mortality rate, all deaths which occur in the hospital without regard to the cause of death or the length of time after operation should be credited to surgery.

The danger of reactions following surgical procedures can be reduced to a minimum by preliminary treatment and painstaking care in the management.

The patients with visceral degenerative changes form the largest part of the mortality list in surgery of exophthalmic goiter. The operative risk is less and the benefits derived are greatest when the patient comes to surgery early in the course of the disease before degenerative changes have occurred.

The avoidance of operative and postoperative complications by painstaking care of details in the management of surgical cases is essential to a low mortality rate in cases of exophthalmic goiter.

THE OPERATIVE TREATMENT OF EMBOLISM OF THE LARGE ARTERIES

A Report of Two Cases

By LEO BUERGER, M.D., F.A.C.S., New York

THE early removal of an occlusive clot from the larger arteries of the extremities, such as the brachial, femoral, or popliteal, gives promise of being an effectual mode of coping with impending gangrene of embolic nature. Unfortunately, the practitioner is not aware of the value of immediate surgical intervention in such cases, and the re-establishment of the circulation is hoped for through the mere institution of conservative methods. The condition should be recognized at the very onset of the arterial blockage, and arteriotomy with removal of the clot should be advised.

It is neither difficult from the diagnostic nor from the therapeutic standpoint to accomplish the localization of the embolus in the case of the upper extremities. Because of the accessibility of the brachial and axillary arteries to the touch, and the deductions that perceptible or imperceptible radial and ulnar pulsations can afford, the recognition of the site of the lesion is easy.

In the case of the lower extremities exact localization may offer a somewhat more intricate problem, but the extent of the coldness of the extremities, its upper limit, and the condition of the dorsalis pedis, posterior tibial, popliteal, femoral, and external iliac pulsations may permit us to restrict the possible territory in which the clot may lie to within a very short distance.

The following instance of the successful removal of an embolus from the brachial artery may be worthy of brief description, for it may be thereby demonstrated that the removal of an embolus about 5 to 6 hours after its lodgment in the brachial artery may be followed by complete restoration of the circulation through the normal vascular paths.

L. G., age 57, was said to have chronic endocarditis with mitral murmur, there having been a previous history of a number of attacks of erysipelas. About September 14, 1922, he was suddenly seized with a cramp in the right leg, lost consciousness temporarily, but recovered without medical assistance. The right leg became cold, blanched, and gradually darker and darker, developing dry gangrene.

The patient was seen by the author on September 20, at which time dry gangrene involving the greater part of the foot, and moist gangrene over the upper part of the leg had already developed, the lower third of the thigh also being cold to the touch. None of the pulses from the femoral downward was palpable.

Diagnosis: embolic gangrene.

September 21, 8:35 a.m., a typical circular amputation (without tourniquet) was done by the author through the upper fourth of the right thigh, the femoral artery being found filled with recent clot. At 2:45 p.m. of the same day the nurse was unable to obtain a pulse in the *right arm;* she noticed that the fingers were very cold, the hand pale, and that the patient complained of numbness and weakness in the corresponding hand and forearm. This condition was also observed several hours later by physicians, who recognized the embolic nature of the arrest of circulation in the right upper extremity, but the matter was not reported to the author.

The patient was seen by the author at 7:15 p.m. of the same day, and the following status noted: the general condition of the patient was fairly good; the right hand and forearm were cold and pale; neither the radial nor the ulnar pulsation was perceptible. On palpation along the course of the brachial and axillary arteries the pulse was found absent below the lower margin of the teres major muscle. The diagnosis of *embolism in the upper brachial artery* was made, and the operation of *arteriotomy* was immediately advised.

After consent was obtained, operation was performed at 9:06 p.m. of the same day.

Operation. The skin over the lower axillary and the upper part of the brachial arteries was infiltrated with 1 per cent novocaine solution, and about 2¼ inches of the course of the brachial artery exposed in the typical fashion, and the point of obstruction located. At about the level of the origin of the superior profunda artery a clot could be distinctly felt in the artery, pulsation below this point being absent, and the arterial girth considerably less than that of the vessel above, or at the site of the occlusion.

A Crile artery compressor and one serrefine were applied above and below, and a small incision about ¼ inch in length made longitudinally, immediately over the clot. Just as a compressing and milking movement was attempted in order to force the clot out of the opening, and as a portion of it protruded through the gap, the whole embolus was suddenly projected outward, evidently by virtue of a circulatory force within the artery itself. In spite of the presence of the clamps, bleeding was continuous, copious, and non-pulsatile, so that more intensive compression both above and below was applied. As the slit was opened with two delicate forceps, the bleeding which continued in spite of change to the above measures, caused the sudden evacuation of a small shred-like clot, evidently a tail-piece or accretion clot, that had blocked either the superior profunda or was riding upon the embolus in the brachial.

In view of the uncontrollable bleeding through the artificial orifice, it seemed evident that the artery had been opened just opposite to the point of origin of the superior profunda artery, through which a collateral reflux was going on.

It was decided, in view of the importance of the superior profunda as an anastomotic channel, to attempt closure and suture of the artery without tying off this vessel. After thoroughly lubricating the vessel with sterile albolene, the longitudinal aperture was compressed and closed with the thumb and index finger of the left hand. Then arterial suture was begun from above downward, with the finest silk (doubled) and the finest and smallest Kirby needles (Carrel pattern). Running suture was easily applied, the assistant pulling taut, tying the first knot, the last knot being tied by the operator. After the removal of the clamp not a drop of blood oozed out of the suture line, and it was not deemed wise to reinforce this.

Pulsation and dilatation of the brachial artery below were immediately restored, and the pulsations were confirmed to exist in the corresponding radial and ulnar arteries by an assistant.

Inspection of the fingers and hand immediately after the wound was closed demonstrated a return of color and warmth to the hand and forearm, and restored motility. The patient also noticed a prickling sensation throughout the fingers and hand.

Although the incision in the arm healed by primary union and the pulses were restored and remained so, the patient succumbed subsequently to the lodgment of multiple emboli, one in the left external or common iliac artery, and another possibly in a vessel of the right half of the cerebrum.

On September 28, 8 a.m., the left leg suddenly became cold and blanched, the femoral and the popliteal pulses being imperceptible. From then on the usual manifestations of early gangrene developed, the cyanotic discoloration of the foot and leg, and the coldness which extended up to the groin.

Although the patient was seen about one hour after lodgment of embolus in iliac artery and operation for it was advised, consent was withheld.

September 29, the patient was distinctly weaker, pulse more irregular, and he was at times irrational.

September 30, sudden left-sided palsy, cerebral disturbances, exitus. Up to the time of death the right radial pulse remained as strong as the left and the circulation of both arms equally good.

In short, this is a case in which embolectomy with removal of a large clot from the right brachial artery was successfully performed, with restoration of the circulation, until death which occurred 9 days after the operation.

Another case is instructive even though the patency of arterial channels situated at some distance from the site of the removed embolus could not be restored.

In a young man operated upon for gangrenous appendicitis by a colleague,[1] February 14, 1920, the right forearm suddenly became cold, cyanotic, and motionless early in the morning of the third day after the operation. The brachial artery did not pulsate below its upper fifth. The diagnosis of embolism was made.

February 17, some 3½ hours after the onset of the symptoms, the author exposed the upper portion of the brachial artery at the site of the thrombus, under novocaine anæsthesia, and by arteriotomy removed a clot about 2 centimeters in length, closing the artery by suture according to the Carrel technique. There was excellent pulsation in the brachial below the site of the clot, and no leakage after completion of the suture. In spite of this demonstrable patency of the brachial artery below the site of the embolus and thrombus, *no pulsation* could be detected in the radial artery. It was, therefore, believed that secondary clots had previously become detached and lodged in the peripheral vessels, or had grown upon the embolus (stagnation clots).

February 18, in spite of the re-establishment of the circulation in the lower brachial artery, the right hand was somewhat cold, but there was definite evidence of *marked improvement in its circulation*. On February 19 the color of the thumb looked doubtful, being somewhat cyanotic and cold. Furthermore, there were signs of muscular palsy and some tendency to contracture of the fingers in the flexed position. Extension of the hand seemed impossible, although motion of the fingers was excellent.

On February 20, after the application of dry heat in an electric baking apparatus in which a contact burn could have taken place, *trophic disturbances* became manifest over the posterior surface of the forearm. A long whitish area suggesting dead skin with loss of sensation over at least 3 inches by 1.5 inches appeared. There was another similar smaller area over the posterior aspect of the wrist and the skin just above. Later in the day, the central portions of these areas showed blebs.

[1] Dr. P. Aschner.

On February 25 the fact that a certain amount of gangrene would develop was well established, since the following lesions could be demonstrated; first, the trophic lesions; second, evidences of gangrene; third, circulatory disturbances.

The trophic lesions: The areas of circulatory insufficiency were well demarcated on February 25, there being an elongated area some 3 inches by 1.5 inches, surrounded by a well-defined, narrow line of deep red, as if a red chalk mark had been drawn around it. Within this there was a distinctly white zone less than 1 centimeter in diameter enclosing a central, purplish space, in which the typical blebs of gangrene were to be seen.

As evidences of gangrene, the thumb showed a deep purplish color, was somewhat withered, evidently in the early stage of gangrene.

Circulatory changes: Although the postero-external aspect of the forearm was fairly warm, the internal aspect changed color, suggesting a possible future necrosis. Between the thumb and the dorsal trophic disturbance, over the thenar eminence and thereabout on the posterior surface, there was a peculiar ham-colored red with diminished temperature due to marked circulatory disturbances. The four fingers, however, were in fairly good condition, their color good, and the patient could move them.

The following notes were furnished me through the courtesy of Dr. P. Aschner.

February 23, or 6 days after thrombectomy—slight wrist drop developed, and there were definite sensory and motor phenomena, said by the neurologists to have been due to implication of the ulnar and musculospiral nerves. In the region of the brachial wound there was some induration, possibly due to deep infection.

March 8, chill and rise of temperature to 105.4° with a negative blood culture, the fever disappearing in 24 hours. March 12, again chill and temperature to 106°, and the blood culture showed hæmolytic streptococci. March 16, some pus was evacuated from the brachial wound. An abscess of the right thenar space was evacuated on March 18; and, on March 20, the temperature gradually attained the normal by lysis.

April 7, the gangrenous area of the thumb had become well demarcated, and the terminal phalanx was disarticulated. A few days later the patient was discharged from the hospital.

In May of the same year the condition of the hand and forearm was as follows:—it was atrophic, weak, of a dusky red color, and the fingers purplish. There were trophic disturbances of the nails, which were discolored and poorly nourished. Hyperhidrosis was also present. In the dependent position, paræsthesia and pain were very severe. Neurological examination demonstrated marked impairment of the motor and sensory functions of the median and ulnar nerves. There were still small sequestra at the site of amputation, and these were spontaneously extruded in the course of the next 4 weeks.

Postular exercises and electrical stimulation were given. Improvement rapidly took place, so that in a month the fingers could be semiflexed. Three months later a normal range of motion was reestablished, the atrophy of the muscles was almost abolished, and the color and texture of the skin approached the normal.

It was reported[1] that on September 7, 7 months after the vascular occlusion, the radial pulse had returned (through collaterals?); one month later the patient was able to resume his work as a chauffeur.

Although successful from the purely technical standpoint, the radial pulsation was not restored until late, due to the presence of thrombi distal to the site of the embolism. Nevertheless, the operative procedure served a purpose in that an additional part of the brachial became patent, and the source of collaterals thereby widened.

In view of the presence of a bacteriæmia, there obtained here an additional factor (probably toxic) predisposing to the extension of thrombi. It has been often observed by the author that stagnation thrombosis may spread rapidly from emboli in the larger arteries in cases of pneumonia and influenza, while the field of obturation is more apt to remain restricted and anastomotic paths conserved in pure cardiac disease and atherosclerosis.

The question of removal of the embolus, therefore, should be entertained *very early* wherever an additional toxic element may vitiate the result. In the above case, although the first clinical manifestations of embolism were noted but about 3½ hours before the operation, the occlusion was doubtless of at least 10 hours' duration, judging from the appearance of the clot. This may be too late; for, on the one hand, time is given for the detachment of clot through the action of reflux currents and motion of the limb into more remote territories, and, on the other, rapid growth of the clot by stagnation, abnormal currents and vortices, and through the forces of ferment liberation, may be expected.

[1] Personal communication from Dr. Aschner.

DIVERTICULITIS OF THE GALL BLADDER

By GEORGE KNAPP ABBOTT, A.B., M.D., Sanitarium, California

INTESTINAL diverticulitis is no longer a postmortem curiosity. From a matter of pathological interest only, it has assumed a place of some clinical importance. Originating in many cases at least in a small mucous ulcer, it gradually deepens until, with inflammatory thickening of the colonic wall and continued ulceration, it becomes a narrow pocket projecting beyond the normal contour of the intestinal serosa. This pocket retains fæcal matter often for days at a time, as shown by barium meal and X-ray examination. It becomes highly vascular and greatly thickened. Not to be confounded with this type of intestinal pathology is the non-inflammatory herniated pouch such as is occasionally found in the duodenum and in other locations. These are usually larger, thinner walled, and show little or no evidence of inflammation or infection. They appear to arise as mucosal hernias through the weakened and separated muscular and fibrous elements of the intestinal wall. I have encountered such at the junction of the transverse and ascending portions of the duodenum. They may be pre-operatively diagnosed by X-ray, having been suspected from the history and symptomatology, and are readily remedied by direct hernial repair of the intestinal wall.

Diverticula of the urinary bladder are indeed very common. They are for the most part due to increased intravesical tension, though occasionally seemingly congenital, and frequently show the changes of cystitis. The diagnosis and surgical treatment of vesical diverticula are well known to the specialist and general surgeon. Diverticula are also encountered in the œsophagus, and have been very thoroughly described by Plummer and others.

With these brief references to diverticulosis and diverticulitis of the œsophagus, intestine, and urinary bladder, I wish to report a case of diverticulitis of the gall bladder. This was not encountered in a highly pathological gall bladder, nor was it merely a pouch due to pressure of gall stones. The entire fundus of the gall bladder itself showed no discernible pathology on gross examination. So normal did it appear that before the diverticulum near the neck of the gall bladder was discovered, I was inclined to think some gross blunder in diagnosis had been committed.

Case No. 10,667 (St. Helena Sanitarium and Hospital), December 28, 1921. J. H. D., a married female, age 35. Complaint—pain under right costal arch. Patient's father had Pólya operation for carcinoma of greater curvature of stomach in 1919, and is still living and well. The mother is living; has much digestive disturbance. An uncle and one grandfather died of tuberculosis. Patient has not been in good health since age of 16. She had malaria at 17, and arthritis, mild, off and on from 1906 to 1910. Formerly had had much tonsillitis, and sore throat occasionally now. She has had no other infections. The left tube and ovary were removed in 1910. Menses were of the 3-day type, 28-day interval; irregular, and mostly early for the last year.

Pain has been present in right side for past 2 years or more, mostly under right costal arch, occasionally in back. The pain is described as a gnawing sensation—not overly severe. A feeling of soreness is present almost all of the time, and especially after working or lifting. Not much gas on stomach. Pain is not related to meals. Patient complains of urinary burning at times; gives a history of "cystitis" in 1919.

Examination. Overweight female; present weight 155 pounds—having gained 30 pounds in last 2 years. Mouth: oral hygiene good, two pieces of crown and bridge work; X-ray shows two apical abscesses. Tonsils cryptic and contain cheesy matter; no cervical adenopathy. Heart: negative. Lungs: negative, except X-ray shows hilus thickening slightly excessive. Abdomen: marked percussion sensitiveness over entire right and left lumbar regions; no especial tenderness over gall-bladder or appendix regions; no notable findings elsewhere. Barium meal shows nothing except a "picking up" of the duodenum in the region of the gall bladder.

Laboratory findings. Blood: hæmoglobin 85 per cent; reds, 4,950,000; whites, 7,400; blood pressure 110-75 millimeters mercury; Wassermann, negative. Urine: negative, except few pus cells. Fractional test meal shows normal curve of hydrochloric acid secretion—no residue.

Diagnosis (pre-operative): cholecystitis with duodenal adhesion; apical abscesses; and chronic tonsil infection.

Recommendations: Cholecystectomy, extraction of abscessed teeth, and tonsillectomy. Teeth extracted January, 1922; laparotomy May 26, 1922. Incision—upper right rectus. Appendix removed; no gross pathology visible. The gall bladder appeared perfectly normal. A little more search revealed an apparent binding of neck of gall bladder to duodenum. In gross appearance this seemed not inflammatory. On releasing it, a small, thickened mass of gall-bladder tissue was revealed. The entire gall bladder was removed, and the cystic duct and artery ligated. A rubber tubing drain was placed and the abdominal wall closed in layers. The drain was removed the fourth day. Convalescence was uneventful. Examination of the gall bladder showed the inflammatory mass to consist of a diverticulum about one-fourth inch in diameter and one-half inch deep. The walls of the diverticulum were greatly thickened and inflamed. There were no gall stones.

The remarkable feature of this case was the presence of a markedly inflamed diverticulum arising from the neck of the gall bladder,—the entire gall bladder otherwise being perfectly normal in appearance.

ANGIOMYOMA OF THE URINARY BLADDER

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AND
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Director of Pathological Institute, London Hospital

CASE HISTORY

DATE, November 8, 1921; subject, a male aged 29 years.

Onset of present illness two years previously when acute retention of urine was relieved by catheter. Since that time he has had several relieved attacks of a similar nature. Four months ago he had a severe attack; catheter passed four times; bladder infected; followed by great pain on passing water, increased frequency and pyuria. Slight hæmaturia was noticed once or twice after a catheter had been passed. No venereal history.

Examination. Nervous system healthy. The urethroscope shows no stricture. Roentgenograms show no stone. Cystoscopy shows urine full of pus, bladder very irritable, bladder wall very much inflamed. A smooth pedunculated tumor can be seen attached to the anterior wall of the internal meatus, projecting from there into the bladder.

After a course of vesical lavage I performed an operation on November 30, 1921, under ether and oxygen anæsthesia.

Operation. The bladder was opened in the middle line and its cavity exposed by an automatic retractor with electric light attached. A smooth pedunculated tumor could be seen arising from the anterior portion of the margin of the internal meatus as shown in the illustration. It was about the size of a date and looked like a ripe raspberry, being obviously full of blood vessels. The pedicle was seized with a curved clamp and pulled forward and upward until a second clamp could be placed well behind the pedicle. The tumor was then sliced off between the two clamps, no ligature being needed. The bladder was stitched up as usual and drained with a small Pezzer tube. The abdominal wall was repaired and covered with strapping over a light dressing.

Course. Lavage with 1:8000 acriflavine through the tube soon put an end to the cystitis. The tube was removed on the tenth day and the fistula healed soundly within less than a fortnight, though convalescence was complicated by an attack of bronchitis. Thereafter the patient passed clear water naturally and with no difficulty or pain and since then he has remained perfectly well. He was seen on March 13, 1922. He could hold water all night, the urine was clear and the stream was free.

A drawing made immediately after the operation represents very fairly the condition seen (Fig. 1). Sections were cut, and illustrations of typical portions are shown. These sections were made the subject of a special study by Doctor Hubert M. Turnbull of the Pathological Institute of the London Hospital, to whom my thanks are due. The report is as follows:

Sections cut from the paraffin block were stained with Ehrlich's hæmatoxylin and eosin, Weigert's iron-hæmatoxylin and van Gieson's mixture, Weigert's fuchselin and neutral red, the Unna-Pappenheim mixture, polychrome methylene blue, dilute carbol-fuchsin, and by the Weigert-Gram method with and without neutral red.

The specimen is an oval polyp with a narrow stalk. The polyp near the stalk is covered by a transitional epithelium composed of five to ten layers of cells. This epithelium lines a few gland-like depressions. Similar epithelium covers one surface of the stalk. As the summit of the polyp is approached, the epithelium thins rapidly and is finally absent. The ulcerated surface is smooth; upon it lies a little

fibrin containing red corpuscles and shreds of necrosed epithelium.

Beneath the epithelial and the ulcerated surfaces is a zone of tissue composed of delicate collagenous and elastic fibers; the zone is in general deep, and is deepest upon the summit of the polyp. The fibers are widely separated by œdema. The superficial layers are infiltrated with numerous neutrophile leucocytes, red corpuscles, and fat-granule cells; in the deeper layers these cells give place to plasma cells. The zone contains numerous, greatly dilated, engorged capillaries and veins. The zone is continued over the stalk as a narrow, subepithelial layer, in which infiltration and engorgement are absent while the collagenous fibers are stouter and much more closely packed.

The center of the stalk and the core of the polyp are occupied by bundles of involuntary muscle and numerous large arteries and veins, in a matrix of stout collagenous and stout elastic fibers. The elastic fibers are specially numerous about the bundles of muscle and thus form a sheath to the bundles; they form a less conspicuous adventitial sheath to the vessels. The muscular and elastic elements in the vessels are normally arranged. The bundles of muscle are directed approximately in the long axis of the polyp. They contain a few delicate, elastic fibers. They are completely separated from the vessels by the matrix described above. The matrix, within the polyp, is infiltrated with numerous mast cells.

The only organisms detected were a few oval, yeast-like, Gram-positive cocci, measuring from 1 to 1.2μ by 0.6 to 0.8μ. They were almost all extracellular and lay in the superficial zone.

Interpretation of microscopic findings. The polyp is acutely inflamed, but its complicated structure shows that it is not a sprouting granuloma. The inflammation is a secondary phenomenon and has been excited from the surface, as is demonstrated by the distribution of the infiltrating cells. The structure of the polyp is essentially similar to that of the bladder. The epithelial covering resembles that of the bladder in structure and depth. The œdematous, inflamed, outer zone has the structure of the mucosa of the bladder. The central core resembles the muscularis of the bladder, except in that it contains abnormally large and numerous vessels; the size and number of these vessels is very striking when comparison is made with a section of normal trigone. The muscle bundles are not connected with the formation of the vessels, as is the case in some angiomata; the vessels are perfectly formed and are absolutely distinct structures.

The polyp is, therefore, an excrescence of muscularis, mucosa, and epithelium, supplied with abnormally large and numerous vessels. It is difficult to find a satisfactory nomenclature. Inasmuch as the polyp consists of a protrusion of the wall of the bladder in which the component parts, including the vessels, are normally arranged and related, and are apparently directly continuous with the same components within the wall of the bladder, such as "leiomyoma" and "angioma" are excluded by the accepted definitions of true neoplasms. The polyp is an error of development rather than a neoplasm as usually defined. This could be expressed by the term "hæmartoma." But to distinguish it thus from certain accepted benign neoplasms, such as polypoid fibro-adenomata of the intestinal tract and villous growths of the bladder, would be to make a distinction with little appreciable difference. To the designation "papilloma" there could be little objection were it not that this name is commonly applied to tumors in which epithelial proliferation plays an important part. This objection would perhaps be overcome by calling it a "polypoid papilloma of muscularis of bladder." To draw attention to the excessive development of vessels, the qualification "vascular" might be added: "polypoid, vascular, papilloma of muscularis of bladder."

Accurate classification of this tumor is a matter of difficulty. It is undoubtedly a benign tumor and it consists chiefly of an overgrowth of blood vessels and of unstriped muscular fibers. It is not a simple myoma, nor is it a "papilloma" of epithelial origin in the ordinarily accepted sense. Perhaps the term "angiomyoma of a polypoid papillomatous form" is the nearest definition that can be attempted.

The best account of non-epithelial tumors of the bladder that I have been able to find is in Howard Kelly and Curtis Burnam's book *Diseases of the Kidneys, Ureters, and Bladder*, 1914, vol. ii, chap. xxxvii. Kelly describes growths of the bladder which spring from its muscle fiber or connective tissue, namely, myxoma, fibroma, sarcoma, myoma, rhabdomyoma, angioma, dermoid and chondroma. Myxoma is found chiefly in childhood and is very rare. Fibromyxoma is rare and usually occurs in childhood; Kelly reports three cases from the literature.

Fibroma is a little less rare, originates in the submucosa and grows out into the bladder. Its distinguishing feature from papilloma is that the main vessels run between the mucosa and the tumor, and do not plunge directly into the body of the tumor. Clado cites 25 cases, Legueu adds 3 and Judd[1] adds two more.

Sarcoma may occur at any age, 10 per cent only in childhood. Albarran collected 53 well established cases from the literature.

Myomata may grow into the lumen of the bladder and become pedunculated, they may

[1] J. Am. M. Ass., 1912, lx, 1788.

occupy the wall of the bladder or they may push their way to the outside of the bladder. Albarran collected 21 cases, and Judd found two in 114 cases of bladder tumor observed at the Mayo Clinic.

Angioma. Kelly reports one doubtful case observed in 1851, one postmortem case worked out by Albarran in 1892, and a case reported by Robert C. Bryan[1] which was operated upon.

Angioma is therefore one of the rarest if not the rarest tumor arising in the urinary bladder. The only case I can find which closely corresponds to the one I have described is a case of angiomyxoma reported by E. S. Judd and S. W. Harrington.[2]

CASE REPORT

A woman, age 19, complained of incontinence of urine, which began 2 years previously, and stated that there had been blood and pus in the urine for 2 weeks.

Physical examination showed a large cystic tumor. Catheterization seemed to reduce this mass to about three-fourths of its original size. Pelvic examination revealed a mass behind the bladder. Cystoscopic examination showed a large tumor mass involving the right wall and base of the bladder and attached around the sphincter. The left meatus was normal; the right was not seen.

Operation. Stage I. Extraperitoneal removal of an enormous polypoid tumor filling a greatly hypertrophied bladder. There was an opening in the right anterior wall of the bladder through which the growth extended into the right extravesical space.

Stage II. An extravesical growth the size of a grape fruit was excised and the opening in the bladder, two inches in diameter, was closed. The pathological diagnosis was papillary angioma. The patient was recovering when last seen.

A case of angioma of the bladder which does not correspond very closely to this case is reported by Launay, Achard, and Carriere.[3]

A woman, complaining of pains in the right iliac fossa which were sharp and intermittent, of imperious and painful micturition, and of intermittent hæmaturia, was brought to the hospital. Examination showed that the pain in the right iliac fossa was greatest at McBurney's point, and that the uterus was scarcely movable. The case was diagnosed as appendicitis.

Operation. A median subumbilical incision was made. On opening the peritoneum, a lobulated hard tumor the size of an orange could be seen on the posterior and right lateral face of the bladder. A

[1] Tr. South. Surg. & Gynec. Assn., 1909, xxii, 578.

[2] Tumors of the urinary bladder. South M. J., 1918, xi, 129.

[3] J. d'urol. méd. et chir., Par., 1920, ix, 385-390.

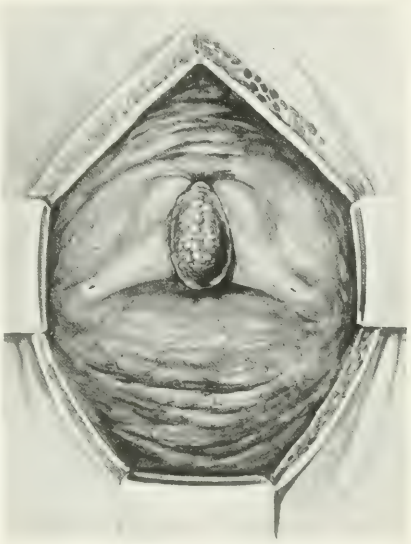

Fig. 1. Drawing showing condition in authors' case.

partial cystectomy was performed and the whole tumor removed. The bladder and the peritoneum were closed, a drain being first placed in the peritoneal cavity. Three weeks later the patient left the hospital.

Macroscopic appearance of the tumor. It was divided into two parts, one part globular and very hard and the other a glossy surface, softer than the first part.

Microscopic examination. The subperitoneal part of the tumor was made up of connective tissue in which the blood vessels were dilated and filled with blood. In the cystic part of the tumor the connective tissue was infiltrated with small blood clots.

Albert J. Scholl, Jr.,[4] in a paper from the Mayo Clinic, "Histology and Mortality in Cases of Tumor of the Bladder," reports as follows on "angioma of the bladder":

"Angiomata are rarely found in the bladder. They may be small, and their only symptom a persistent, profuse hæmaturia; or they may be extensive, penetrating into the perivesical tissues, and simulating growths of other pelvic organs. In most cases they are composed of anastomosing dilated cysts filled with blood;

[4] Surg., Gynec. & Obst., 1922, xxxiv, 189.

Fig. 2.

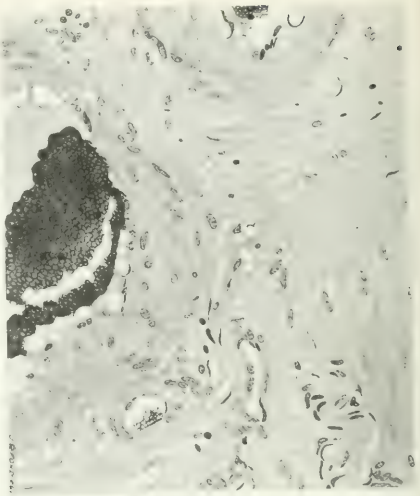

Fig. 3.

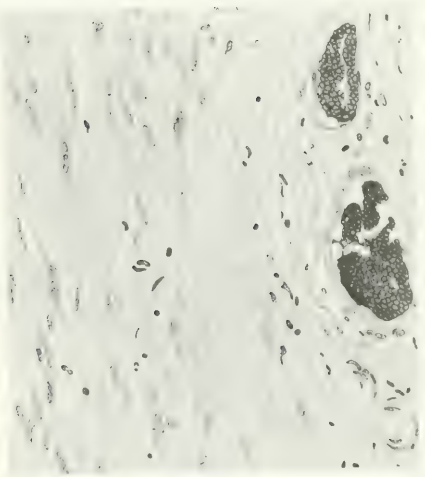

Fig. 4.

Fig. 5.

Figs. 2 to 5. Microscopic sections in authors' case.

rarely they occur as branching masses of apparently recently formed blood vessels, supported by a fibromyxomatous stroma. Watson found only two angiomata in 653 collected cases. Albarran collected three cases from the literature and reported one of his own which occurred in a series of 106 cases observed personally. In Albarran's case the tumor, which he removed surgically, was very small; it was attached to the trigone and bled profusely. Thomas has described a similar small angioma which was removed by fulguration. Lane has described a large inoperable cavernous angioma in a child of 3 years. Jungano has described a massive cauliflower angioma in the region of the trigone undergoing sarcomatous degeneration in a man aged 54 years. Launay has reported the case of a girl aged 19, in whom a large submucous angioma was removed from the postero-lateral wall of the bladder. The tumor was firm in spite of many cavernous dilatations.

"In the series of 262 cases there were three angiomata:

"A girl (Case 14028, Fig. 15), aged 19 years, had had pus and blood in the urine, and mild incontinence for 2 years. At operation a large polypoid tumor was found filling an enormous bladder. The tumor extended into the perivesical space through an area about 3 centimeters in diameter. The tumor was completely removed. Four months later a small recurrent growth was successfully fulgurated. Five years later the patient was in excellent health; her bladder appeared normal and its function was normal. The tumor in this case was firm, and contained many blood cysts and sacculations, but the larger part of the growth was composed of fine interlacing blood vessels supported by connective-tissue stroma, simulating a highly vascular myxoma.

"A man (Case 151866, Fig. 16), aged 76 years, had had occasional attacks of hæmaturia and moderate frequency for the last 8 months. On examination an inoperable sessile growth covered with papillomatous excrescences was found on the left base of the bladder reaching up to and involving the urethral sphincter. The growth was extensively fulgurated. Seventeen months later, after a period of comparative relief, the urinary symptoms returned. Examination revealed a wide-spread mass covering the entire left half of the bladder and involving the prostate and posterior urethra.

"A girl (Case 18434), aged 7 years, had had persistent slight hæmaturia for 6 years; recently a small amount of blood had passed from the rectum. A mass 6 centimeters in diameter was palpated in the region of the bladder. Cystoscopic examination revealed an ulcerated bleeding tumor in the base of the bladder. Soon after, before operation could be performed, the patient had a severe hæmorrhage from the rectum and died. Necropsy revealed an extensive cavernous angioma growing from the base of the bladder and invading the rectal mucosa."

CONCLUSIONS

1. Angioma or angiomyoma is probably the rarest type of tumor met with in the urinary bladder.

2. If a diagnosis can be made at an early stage, operation may be successful and should lead to a permanent cure.

3. If not detected until a late stage, an operation may be impossible and death may occur from hæmorrhage.

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PRIMARY CARCINOMA OF THE URETHRA

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THE occurrence of carcinoma primarily in the urethra of the male or female is sufficiently rare to warrant a review of published cases and a report of three such instances of our own.

Riberi has been credited with reporting the first case of cancer of the female urethra in 1844, but Percy states that Bowin first described this condition in 1833. M. Wassermann (1), in his thesis in 1895, collected 24 cases; Serph (2) 30 cases in 1901. Percy (3), after a critical study of the literature in 1903, considered that there were only 12 undoubted instances, and that 3 of these were sarcomata. He excluded all those with involvement of anatomical structures other than the urethra. Many of the cases reported in the literature are quite incomplete, and in the majority the growth had extended greatly beyond the urethral focus. Karaki (4), in 1908, collected 53 reports; Whitehouse (5), in 1911, found only 43 records of undoubted urethral cancer in the woman. Venot and Parcelier (6), in 1921, gave the histories of 87 instances collected from the literature, and 1 case of their own. In addition one or more cases have been reported by Eicke (7), Boyd (8), Menge (9), Franke (10), Croft (11), Ball (12), Boursier (13), Hirst (14), Gibson (15), Fairbairn (16), Engelhardt (17), Maiss (18), Horand (19), Bachrach (20), Starck (21), Watson (22), Crossen (23), Shoemaker (24), and O'Neil (25).

Accepting the collection of Venot and Parcelier as the most accurate recent compilation, together with the additional cases found in the literature and not quoted by them, and considering all cases reported under the heading of urethral carcinoma, whether they arose from polypoid degeneration, or where neighboring structures were involved, we find reported 120 instances of this type of new-growth.

The incidence is not so great in the male. Hall (26) collected a series of reports up to 1904. Preiswerk (27), in 1907, compiled 42 instances from the literature, but omitted 6 of Hall's cases. In a criticism of the subject Conforti (28) thinks that 4 of Preiswerk's cases ought not to be admitted, as they were reports of epitheliomatous fistulæ. O'Neil (25) added the reports of 10 cases in 1921. There are, however, several records in the literature not included in any of the papers mentioned. Barabino (29), Malanssene (30), Ottow (31), Olivier and Clunet (32), Allenbach (33), Bierbaum (34), Rizzi (35), Menocal (36), Remete (37), Yves Tizon (38), Conforti (28), Kroiss (39), Shattuck (40), Tansini (41), and Burckhardt (42), have added one or more reports to the total, bringing the number to 73. To these we wish to add the reports of 3 cases of our own, two occurring in the female and one in the male.

Case 1. M. H., a widow, age 65, admitted to Cook County Hospital on May 12, 1922, complaining of pain in the left lower quadrant of the abdomen and left flank, pain and difficulty in urinating, and general weakness.

For the past 2 or 3 years the patient had suffered from urinary disturbances consisting of frequency and burning on urination, and for which she had never consulted a physician. For the past 3 weeks she had been complaining of the pain in her left side and abdomen, and this had become progressively worse, radiating into the left thigh. It was of a dull, aching, constant character, occasionally accompanied by sharp, shooting, cramp-like pains. Her weakness had been a progressive one, finally marked by a semi-comatose condition the greater part of the time. She had never made any complaint of a tumor growth, or of any symptoms referable to the genito-urinary tract beyond the frequency and burning on urination. Recently this frequency had become very pronounced, with nocturia of three or four times.

There was no history obtainable of any previous illnesses, and the family history so far as could be determined was negative for carcinoma. Her menstrual periods began at 17, and were apparently normal up to the time of her menopause at 52. She had been married for 40 years, and had given birth to six children.

Physical examination revealed a poorly nourished adult white female, very anæmic, and appar-

Fig. 1. Case 1. Drawing showing the enlargement of the urethra as seen from the exterior.

ently very weak. The essential findings consisted of marked emaciation, abdominal tenderness, especially in the left lower quadrant and extending as high and laterally as the lumbar region and accompanied by muscular rigidity and some fullness in the flank, and the findings on vaginal examination. The introitus was relaxed and the opening gaping. The examining fingers encountered a firm, nodular mass apparently surrounding the urethra, but not involving the vaginal mucosa, and extending as far as the neck of the bladder. This mass was estimated to be about one-half inch thick. On introduction of a small sound into the urethra the mass was further accentuated, and so far as could be determined surrounded the urethra throughout its course. The meatus was markedly enlarged, but externally there was no evidence of tumor growth. The uterus was small and atrophic, and exhibited a small cervical polyp, which on removal and histological examination showed no evidence of malignant degeneration. The cervix was otherwise normal as were the adnexa. Cystoscopic examination revealed the presence of a marked generalized hæmorrhagic cystitis, with some bullous œdema about the vesical neck, but no evidence of tumor growth intravesically. Catheterized urine specimen showed the presence of albumin and a large number of pus cells. The white blood cell count was 7,000. A diagnosis was made of primary intra-urethral carcinoma, with secondary pyonephrosis.

The patient's condition precluded any operative interference, and exitus was inevitable. Autopsy examination was performed with the following anatomical diagnosis: primary carcinoma of the urethra with extension metastasis to the neck of the bladder; bilateral pyonephrosis; chronic diffuse nephritis; petechiæ of the renal pelves and beginning of the ureters; dilatation of the renal pelves; moderate œdema of the lower lobes of the lungs; senile atrophy of the spleen, fallopian tubes, ovaries and uterus; fibrosis of the aortic leaflets; slight senile arteriosclerosis; old healed tuberculosis of the apex of the left lung (Figs. 1 and 2).

Microscopic examination of a cross section of the urethra presented the picture of a very malignant process. Numerous mitotic figures were seen, and direct extension of the cancer cells had irregularly taken place deep into the urethral musculature. At the vesical neck only had the process extended beyond the limits of the urethra. Here the sphincter of the bladder was involved by direct extension, but the vesical mucosa was everywhere free from new-growth (Fig. 3).

Case 2. Mrs. T. A. V., age 38. With the exception of typhoid fever at the age of 12 years, there had been no previous disease or accident. Her first complaint relative to her present condition had occurred 7 months before her examination by us, and consisted of painful sexual intercourse. This symptom rapidly became more severe, and within 2 months from the time of its appearance it was impossible to perform this act. At about this time it was observed by the patient that there was a vaginal protrusion. An attempt was made by a physician to replace this mass but without success. Nothing further was attempted in the way of treatment, and during the next 2 months a constant pain in the "region of the neck of the bladder" developed, which was markedly increased on sitting down. During the next 3 months this symptom increased only moderately in severity.

One month from the beginning of the symptom of pain, there occurred a gradually increasing frequency of urination which developed to such an extent that within 4 months there was both nocturnal and diurnal partial incontinence of urine. There has been no hæmaturia or loss of weight, but a considerable loss of strength during the 7 months following her initial symptom.

Examination found a well-nourished, middle aged woman, whose general physical condition was normal. Locally there was an elongated rounded mass in the region of the urethra extending back into the vagina to within 1 inch of the uterine cervix. The consistency of this mass was constantly firm, and its outline regular. The mass was so extensive that the examining fingers were inserted into the vagina with difficulty, even when the patient was under a general anæsthetic. On cystoscopic examination the urethral meatus was normal. A No. 18 F. cystoscope was passed with moderate obstruction, and there were 4 ounces of residual urine in the bladder. The vesical mucosa was normal except for œdema about the vesical neck. Urethroscopy revealed a markedly irregular and hyperæmic urethra throughout its course. Considerable oozing of blood was noted along the entire urethral tract. A diagnosis of primary intra-urethral carcinoma was made, but not confirmed by biopsy as it was decided to treat the condition with radium.

Fig. 2. Case 1. Drawing showing the interior appearance of the bladder and urethra. Note the ulceration in the lumen of the urethra, also the marked trabeculation of the vesical wall. No tumor tissue is seen within the bladder.

On April 24, 1922, 2600 milligram hours of radium by means of a vaginal pack was applied. There was no constitutional or local reaction. On May 15, there was no apparent change in the character of the tumor, although there was some improvement in the symptoms. On this date 1200 milligram hours of radium by means of radium needles were inserted into the urethra from the borders of the external meatus. There was no constitutional or local reaction for 2 weeks, at the end of which time ulceration was definite, and there occurred a sloughing of the entire urethra, without apparent damage to the vesical sphincter. One month from the last application of radium acute retention of urine developed, which was soon followed by an overflow bladder. Two months from the last application of radium the general condition is excellent, the pains have entirely subsided, and the bladder is constantly emptied by means of a vesicovaginal fistula, which has been present for 6 weeks.

Case 3. Mr. W. G., a laborer, Irish, age 71, entered Cook County Hospital November 8, 1921, complaining of pain in the penis, swelling of the penis, and difficulty in urinating. He stated that at the place where he had been working he had accidentally been scalded by a stream of steam about 11 months previously. The pain from this had been very severe at the time, but had gradually abated with the exception of a dragging-down sensation which had persisted. About 3 months after the accident, he first noticed that the under surface of the penis near the glans began to get hard, and this area of firmness

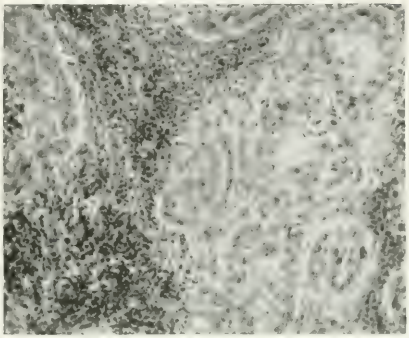

Fig. 3. Case 1. Typical field from a cross section of the urethra. Mitotic figures are seen in the cancer cell groups. Marked round-cell infiltration is noted throughout the tissue. (×135.)

had increased in size until it involved the greater part of the distal half of the penis, but did not involve the glans or skin surface. Difficulty in urinating had been present for the past 2 weeks, and during this period he had been sounded several times by a physician with some relief, though it was generally necessary for him to strip the penis in order to clear the urethra from retained urine. Accompanying the difficulty there had been considerable burning pain on urination. He felt that he had been getting very much weaker lately, and had lost about 10 or 15 pounds in weight. Beyond the usual diseases of childhood he had never had any serious illnesses, and his family in general had all attained a very old age, and in none of them could he remember the occurrence of cancer.

Physical examination revealed a fairly well developed, rather poorly-nourished, adult white male not appearing acutely ill but seemingly very weak. The essential findings were confined to the genitourinary tract. The penis exhibited a cord-like, indurated mass extending from the corona of the glans to the penoscrotal junction, along the under and lateral surfaces. The skin was not involved, sliding easily over the shaft of the penis. The urinary meatus was somewhat reddened but showed no evidence of tumor tissue, nor was the glans involved. A very fine stream was passed on urination, the act causing some burning and pain. Both testicles were present in the scrotum and with the epididymides presented no abnormal findings. Rectally the prostate was very slightly enlarged, smooth, regular, and not tender. The seminal vesicles were apparently normal. Bilateral inguinal indirect herniæ were present, together with a moderate inguinal adenopathy. Beyond a moderate degree of arteriosclerosis and the usual senile changes, further physical findings were entirely negative or normal.

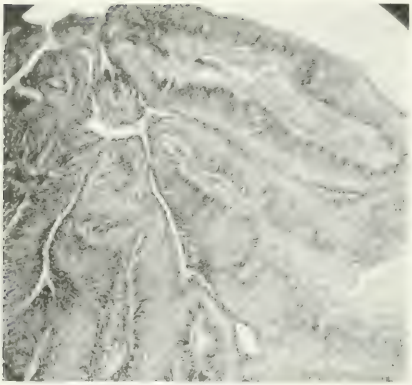

Fig. 4. Case 3. Showing definite papillary protrusions pointing toward the urethral lumen.

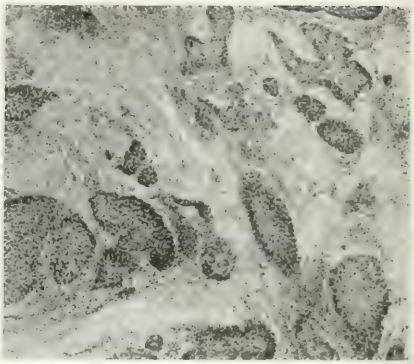

Fig. 5. Case 3. From same section as Figure 4 but deeper into the urethral tissue, showing the invasion of corpus spongiosum by cancer cells (× 60).

Urine examination showed the presence of albumin, a few red blood cells, many pus cells, but no casts. The blood Wassermann was negative. Blood cell count showed 4,100,000 red cells; 9,200 white cells; hæmoglobin 68 per cent. Blood chemistry examination gave the following figures: urea nitrogen 17.62, urea 37.70, creatinine 1.62, sugar 75.00. Diagnosis of carcinoma of the penis primary in the urethra was made, and radical amputation with the establishment of a perineal urethral opening decided upon and done.

Histopathological examination of the removed organ showed extensive infiltrating masses of large atypical cells arranged in rows forming definite papillæ which extended into the lumen of the urethra. Many such cells were seen invading the corpus spongiosum. The microscopic picture as a whole suggests a neoplasm of relatively low-grade malignancy, and must be classified as a papillary carcinoma of the urethra (Figs. 4 and 5).

The patient had a rather stormy convalescence, but eventually left the hospital in good condition. The wound had healed by primary union, but there still persisted some urinary incontinence and considerable discomfort from the leakage of urine. However, 6 months from the time of the operation the patient was seen again. He stated that he had perfect control over urination, all burning and distress had stopped, his appetite was good and he had put on about 15 pounds in weight. It had been our original intention to complete the operation by the removal of the inguinal chain of lymph glands, and on leaving the hospital the patient had been instructed to return at intervals for X-ray treatments which he neglected to do. However, the glands at this time were practically of normal size, their former enlargement undoubtedly having been due to inflammatory changes rather than to metastasis. The clinical result is in accord with the microscopic finding of a relatively low-grade malignancy.

Venot and Parcelier discuss the question as to what should be described under the title of carcinoma of the urethra, and conclude that if only the cases in which the urethra alone is involved should be admitted, then there are only fourteen instances of primary carcinoma of the urethra in women reported in the literature. But as a matter of fact patients are not usually seen until the disease has already greatly surpassed its limit of origin. The same is equally true in the male where retention of urine is not a marked early symptom. Consequently the opportunity of observing urethral cancer in its initial stage is rarely obtained.

Ehrendoerfer (43), and others, have desired to create two categories of urethral carcinoma: (a) urethral cancers, properly so called, originating at the expense of the urethral epithelium or its glands; and (b) those originating at the expense of the epithelium surrounding the meatus, and secondarily involving the urethra.

In considering carcinoma of the female urethra, Venot and Parcelier accept this classification with reservations and state that there may then be:

1. True urethral types, which may be:

a. Ulcerous type, which is rare, only three cases being recorded;

b. Infiltrative type, somewhat more common, although Percy found but 16 cases in 1903; Karaki, 19 in 1908, while Whitehouse in 1911 admitted only 11.

2. Vulvo-urethral types, which may be:

a. Polypoid or papillary, some 15 reported instances having been found to belong to this class;

b. Ulcerous, in which the neoplasm starting from the meatus or its vicinity, hollows out and destroys all the neighboring tissues. They have found 7 cases exemplifying this type in their investigation;

c. Infiltrative type, that in which the neoplasm invades the tissues step by step. It is the type most commonly met, and usually begins as a small meatal tumor, soon invading the vestibule, urethrovaginal septum, and surrounding structures.

The same classification, with suitable alterations, may be applied to the male. The true urethral types arising from the urethral epithelium or its glands, and being either of an ulcerous or infiltrative character; and the para-urethral types arising from the epithelium surrounding the meatus, and involving the urethra secondarily. This latter may be of the ulcerous character, such as is rarely seen following chancroidal infections with subsequent malignant changes; or of an infiltrative type, spreading from the glans or surrounding structures and gradually involving the urethra; and finally those cases resulting from the malignant degeneration of papillomata in the region of the meatus.

Histopathologically the cases are squamous, columnar, or adenocarcinomatous in type, the latter being the most uncommon. Watson (22), states that according to Whitehouse (5), squamous-celled carcinoma is the preponderating type of growth, Of his 43 collected cases, 27 were of this variety; 2 are described as a combination of epithelioma and columnar-celled carcinoma, while adenocarcinoma is rare, originating in the peri-urethral glands, and only 14 cases being reported.

As in malignant tumors elsewhere in the body, the direct cause is wanting. Reports indicate susceptibility in ages ranging between 40 and 60 years, for both sexes. Leucoplakia has been considered by some authors as important. Caruncle as a forerunner is undoubtedly of considerable consequence, although mentioned in only about 10 per cent of the cases in the literature. Especially does this seem to be true in the cases which have been frequently cauterized, the ensuing chronic irritation playing an important part in the malignant degeneration of these tumors. Stricture and chronic urethritis in the female are not generally considered important factors, while trauma and predisposition are given considerable weight by the majority of authors. In the male, O'Neil (25) gives the predisposing causes as trauma, leucoplakia from chronic urethral irritation, and stricture formation, the latter being present in 50 per cent of the cases. He believes that in the majority of instances the lesion arises from the bulbous urethra, and this is certainly the most common site for stricture formation. Rizzi (35) found a traumatic history in only 10 per cent, and a gonorrhœal history in 60 per cent of his cases. He determined the sites most frequently affected to be: cavernous portion 52 per cent, bulbous urethra 25 per cent, and membranous and prostatic portions 22 per cent. Barabino (29) thinks that the most common causes are chronic infections of the urethra and predisposition

The onset is usually insidious, and no symptoms may be experienced until the lesion is well under way. Venot and Parcelier state that when the growth is well established, the symptoms of pain, urinary disturbances, and hæmorrhage are the outstanding features. The pain is usually not intense but radiates into the thigh, pelvis, and vaginal fundus. There is sometimes pain on coitus, especially if there is ulceration. Urinary disturbances are constant and usually are the first to attract the attention of the patient. Frequency, pain on urination, retention, and finally incontinence, complete or partial, make up the picture. A few cases are reported in which the evolution was without urinary disturbances. Hæmaturia, which is stated to be rare, is often thought to be of genital origin by the patient. The general condition is affected

only when the local condition has become very advanced. Objectively the condition may present under any of the three forms given: the polyp or papillary form, the ulcerous, or the infiltrative type. Inspection and palpation serve to disclose the presence of tumor growth, while endoscopic examination, which is less satisfactory and sometimes very difficult, may be of value. The passage of a small sound will serve to accentuate the localization of the tumor to the palpating finger.

In the male, O'Neil (25) states that the early symptoms are not characteristic, and are such as would coincide with ordinary urethral stricture, namely, disturbance of micturition, hæmorrhage, hæmaturia, and a purulent discharge. As the condition advances there may be swelling of the perineum and extravasation of urine. Pain is usually limited to the act of urination, except when the condition has become well advanced, when it may be more or less constant. The general condition is affected in proportion to the advancement of the new-growth. On physical examination the tumor mass is recognized by palpation and inspection, and the use of the endoscope, where possible, may be of value. In the male and female alike, inguinal adenopathy of varying degree is usually found.

The diagnosis is made from the history, physical findings, and biopsy report. In any doubtful case the latter procedure is essential, and in all cases showing a tumor growth about the urethra, the diagnosis should be suspected. In the male it may be necessary to differentiate the condition from stricture with extravasation, or urinary fistula, and without a biopsy this is often impossible. O'Neil states that many cases have been operated upon one or more times before a diagnosis was made. Careful examination together with a histopathological examination should obviate any difficulty in arriving at a correct conclusion.

There are two recognized methods of treatment, operative procedures, and treatment by physical agents such as radium and mesothorium. According to Venot and Parcelier the following figures are obtainable from their collected cases:

Partial resection of the urethra with suture of the urethral extremity to the mucosa of the vestibule or vulva. These authors find 28 such treated cases without any operative deaths, and with a good functional result in the majority of cases, since there was incontinence in only 3. However, there were nine recurrences among this number.

Total resection of the urethra with the establishment of a neovaginal or suprapubic stoma. Vaginal drainage was done in 22 cases, as compared with 8 of the other type. There were two postoperative deaths, 6 and 8 days after the operation, and the functional results are naturally not so good as in the partial resections. In 22 cases, in 12 only was continence mentioned as obtained after the operation; in four there was partial continence, and in the other cases there was rapid recurrence.

Extremely radical operations are reported in two cases. In the first a symphysectomy with excision of the tumor and formation of an artificial urethra was done. In the second case a two-stage operation was done. The first stage consisted of dissection of the vulvar orifice and meatus. In the second stage a median subumbilical laparotomy was done with hysterectomy and ablation of the urethra *en bloc*. The patient died of shock.

Extirpation of involved inguinal glands has been attempted in 10 cases. Four times in 28 partial resections of the urethra, and six times in 30 total resections. In several instances the removal of the glands was carried out as a second stage procedure, being done several months after the removal of the urethra.

Aside from the cases where an extensive operation was done, the surgical treatment of urethral cancer presents an almost completely absent postoperative mortality. In a few cases where a second operation was done against recurrence the result was without avail. Venot and Parcelier give the results after partial resection of the urethra in their collected cases as: one survival after 6 years, one after 3 years, one after 2 years, one after $1\frac{1}{2}$ years, one after 11 months. After total resection: one survival of 10 years, one of 5 years, two of 2 years, one of 20 months, one of 13 months, one of 1 year. Crossen (23) summarized the results in 25 cases operated upon radically and found: eight cures of more than 3 years, three probable cures after 2 years, eight re-

currences, and six unknown results. In the other cases found in the literature the results are: six cases of recovery with continence, six of recovery with incontinence, one recovery with fair continence, four recurrences, two deaths, and three cases with unknown results. In general plastic operations have been successful in but very few cases.

With respect to the use of radium and mesothorium, this method of treatment is the one of choice in inoperable cases, and from the few reported cases where they have been used, they have shown themselves to be of some benefit, especially in the cases of Blumberg, Legueu, and Condamin, collected by Venot and Parcelier, and that of Shoemaker (24). The combined surgical procedure with the use of radium has also been effective in some patients.

In dealing with cases of carcinoma of the male urethra, the same measures have been used with varying degrees of success. Of 10 collected cases by Hall (26) treated by resection or some form of extirpation, the result was unknown in 1, 4 died within 9 months, 1 recurred within 6 months, and in 4 there was no recurrence within 21, 11, 10, and 4 months respectively. Rizzi (35) states that of 25 collected cases radically operated upon there were: 4 primary deaths, 5 recurrences within 6 months, 3 cases cured for 2 years or longer, 13 cases cured for 6 to 10 months. O'Neil believes that early amputation of the penis has given good results where the penile urethra alone was involved.

In operable cases, whether in the male or female, it seems logical to use both surgical measures and radium, or massive doses of X-rays. Just what results might be secured from the use of surgical diathermy combined with the after-use of heavy doses of X-rays is a problem for the future.

The prognosis in these cases apparently depends on the stage which the cancerous condition has reached when the patient presents himself, as well as the degree of associated pathology which may be present. In any event it must be considered grave, for once these tumors have established themselves it appears to be the rule that they evolve very rapidly, and the danger of recurrence following operative procedures is great. Consequently the earlier these cases are seen and diagnosed the better the patient's chances for recovery, provided that recourse is had to the proper surgical procedures followed by the judicious use of X-rays or radium.

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PRIMARY RETROPERITONEAL SARCOMA

Report of Twenty-eight Cases[1]

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THE term retroperitoneal sarcoma, originated by Lobstein, usually includes both primary and secondary growths behind the peritoneum. The secondary sarcomata usually originate in the testicle or ovary and are not included in the report of cases of true primary retroperitoneal sarcoma. Growth in the latter type originates behind the peritoneum in the postperitoneal areolar tissue, adipose tissue, or lymph glands, and occasionally in the vertebræ, independently of any organ, such as the kidney or adrenal.

Steele, in 1900, reviewed the literature and reported 96 cases of primary retroperitoneal sarcoma, including 5 of his own. Trout and Meekins, in 1920, reported 12 additional cases, including 2 of their own, and in 1922, I collected 6 cases from the literature, and added 28 proved cases from the Mayo Clinic, a total of 142 cases. Ten cases clinically diagnosed primary retroperitoneal sarcomata are not included in the series since the diagnosis was not proved microscopically. No satisfactory explanation has been made with regard to the cause of these tumors. The largest tumor on record was reported by Bull and weighed 34 pounds after removal. The microscopic diagnosis of this tumor was myxofibrochondrosarcoma. This study is based on 28 proved cases of retroperitoneal sarcoma.

The ages of the 28 patients in the series ranged from two and one-half years to sixty-two years. Twenty-three of the patients were males and five were females. Rarely is more than one tumor found; multiple growths were present in one case of the series (3.5 per cent). Thirteen of the growths (46.4 per cent) were on the left side, 9 (32.1 per cent) on the right, 3 (10.5 per cent) in the pelvis, and 2 (7 per cent) central; 1 (3.5 per cent) occupied both sides of the abdomen.

SYMPTOMS

The symptoms are insidious, indefinite, and varied. The patients observed in the Mayo Clinic had had symptoms for from 2 weeks to 3 years, or an average for 8 months. The onset is usually insidious with indefinite abdominal pain at times colic-like, nausea, vomiting, and gaseous distention. Pain in the lumbar region and in the leg is a common complaint. The attack may simulate that due to gall stones although the pain is less severe and more constant. Steele considers diarrhœa to be an important symptom; Keen's patients suffered mostly from constipation. Fourteen (50 per cent) of the patients in the Mayo Clinic series had normal bowel function, 2 (7 per cent) had diarrhœa, 8 (28 per cent) had constipation, and one had both diarrhœa and constipation. Two patients had œdema; as a rule it begins at the ankle and extends upward. Six (21 per cent) complained of urinary frequency, 1 had dysuria and hæmaturia, and 1 had ascites. Jaundice, which occurs when the common duct is pressed on by the tumor, was not present. Loss of weight is often marked and rapid and usually accompanied by great loss of strength. Nearly one-half the patients had fever, ranging from 99 to 102, during some stage of the disease. Blood counts were available in 24 cases, in 11 (45 per cent) hæmoglobin was below 70 per cent.

The roentgen-ray aided greatly in the diagnosis by ruling out gastro-intestinal tumors. Its use in conjunction with the cystoscope ruled out genito-urinary masses.

The mass, usually deeply placed, may be mobile or immobile, firm or cystic, smooth or irregular, tender to touch or painless. One of the most characteristic findings is the location of the colon resting in a groove on the anterior surface of the tumor. If the mass is laterally placed, it may be impossible to distinguish it from liver, kidney, adrenal, or spleen. If it is low in the pelvis, rectal or vaginal examination may afford the most valuable information.

Unusual retroperitoneal serous cysts which

[1] Thesis presented to the Faculty of the Graduate School of the University of Minnesota in candidacy for the degree of Doctor of Medicine. Read before the American Medical Association, May 1, 1923.

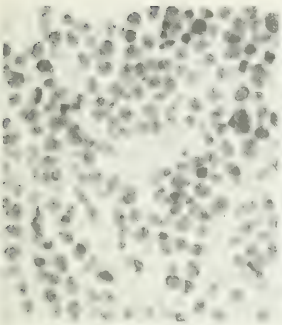

Fig. 1. Lymphosarcoma. (×500.)

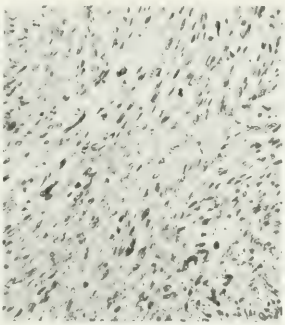

Fig. 2. Spindle-cell sarcoma. (×100.)

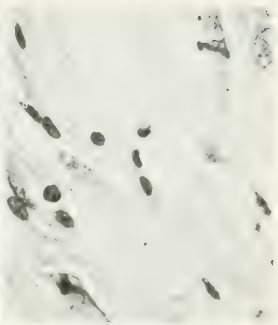

Fig. 3. Fibrosarcoma. (×500.)

may be present may confuse the diagnostician, but these grow slowly and become very large. Aneurysm should readily be distinguished by the pulsation, thrill, or bruit, lack of emaciation and anæmia, and slower growth. Lipomata or myxolipomata grow much more slowly and larger, show marked fluctuation, and cause pressure symptoms much later. Rapid growth in a retroperitoneal lipoma is very apt to mean sarcomatous change. The term, degeneration, is purposely avoided in this connection, as it has been shown that the change from benign to malignant is not one of degeneration, but of very active, though abnormal, generation. Enlarged tuberculous lymph nodes may be distinguished by the history, uniform enlargement of the abdomen, greater emaciation, shorter course, greater tenderness, higher fever, and often by the discovery of tuberculosis elsewhere in the body. It is far more common than is retroperitoneal sarcoma. The most common conditions simulating the growth are ovarian cysts and renal tumors; these can usually be eliminated by careful physical and special examinations.

Metastasis had occurred in about 33 per cent of the series; Steele found practically the same proportion. Metastasis to the liver, lungs, or lymph glands was most common, but the spleen, kidney, skin, omentum, muscle, pleura, heart, bone, spinal cord, dura, adrenal, and mesentery may show secondary nodules.

TYPE OF TUMOR

The most common type of sarcoma in the series was the small round-cell, or lymphosarcoma (Fig. 1) which occurred in 10 of the 28 cases. The next most common was the spindle-cell (Fig. 2) and fibrosarcoma (Fig. 3), each being present in 4 cases. The mixed-cell, fibromyxoma, and myxosarcoma (Figs. 4 and 5) were found in 2 cases each. Small and medium round-cell sarcoma (Fig. 6), myxo-osteochondrosarcoma (Figs. 7 and 8), and giant-cell sarcoma (Fig. 9) were found in one, each; the latter was made up, for the most part, of tumor giant cells.

In the beginning the mass is usually firm and lobulated. Later, it undergoes hæmor-

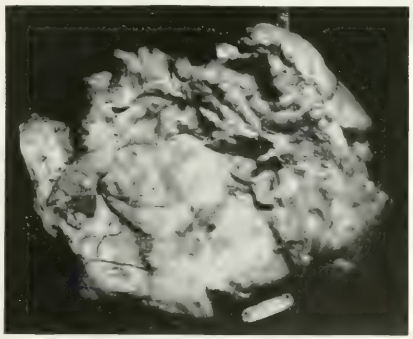

Fig. 4. Myxosarcoma, 3,900 grams.

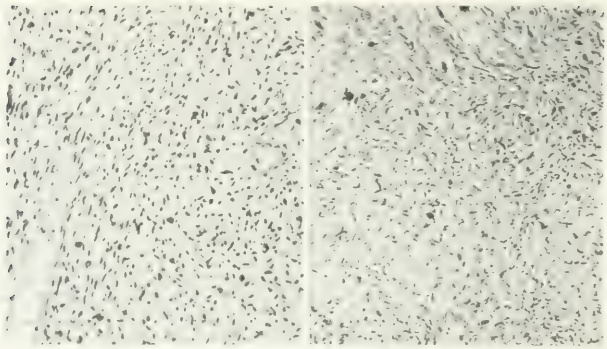

Fig. 5 (at left). Myxosarcoma. (×100.)
Fig. 6. Mixed round-cell and spindle-cell sarcoma. (×100.)

rhagic, mucoid, or purulent degeneration, with the formation of a cyst. On removal, the irregular mass often is found to be encapsulated and quite hard; it may contain lobulated cysts. It offers considerable resistance to cutting, hæmorrhagic areas are not uncommon, and dense whorls of fibrous connective tissue are seen. If it contains muscle it is often salmon-colored; cartilage and bone appear much the same here as elsewhere.

Microscopically, the cells are usually arranged in masses which extend irregularly into strands of more or less dense fibrous tissue. The sarcoma cells are usually associated with abundant capillaries composed of a single layer of endothelial cells. In some instances the blood channels have no endothelium, the blood lying in immediate apposition to the tumor cells. This probably explains the common finding of hæmorrhagic degeneration and metastasis to the lungs and liver by way of the blood stream. The more highly differentiated the cells composing the tumor, the more benign the neoplasm. The most malignant and infiltrative of retroperitoneal sarcomata is the lymphosarcoma, which is the least differentiated. The cells are massed closely, have single deep-staining nucleoli, and contain little cytoplasm; there is very little interstitial connective tissue. In the rapidly growing types, unfortunately the most common types, mitotic figures may be seen.

The medium and large round-cell sarcomata are much less common and also less malignant than the small round-cell type. The cells may be round or oval, the cytoplasm abundant, and the nuclei large. There is more likely to be connective tissue between the cells. Such neoplasms are less destructive and break down more slowly than do the lymphosarcomata.

Large and small spindle-cell sarcomata show the typical elongated, somewhat pointed cells with oval or spindle-shaped nuclei. These cells are arranged in bundles around the capillaries, with quite definite interstitial connective tissue. They are far less malignant than the round-cell sarcomata. It is not uncommon to find a mixture of all these types, as is illustrated in Case 13 of the series. Also the tumors may be combined with various other tissues to form the so-called intermediate types, as illustrated by the osteosarcomata, chondrosarcomata, liposarcomata, myxosarcomata, fibrosarcomata, and so forth. True bone, cartilage, fat, muscle, or fibrous tissue is found in these tumors, with masses of closely packed, rapidly growing, malignant cells.

Giant-cell sarcomata make up only a small part of retroperitoneal tumors. The one giant-cell sarcoma in our series originated, apparently, from the vertebræ, near the bifurcation of the aorta. Giant cells may be present in many sarcomata, but only when they predominate is the tumor termed giant-

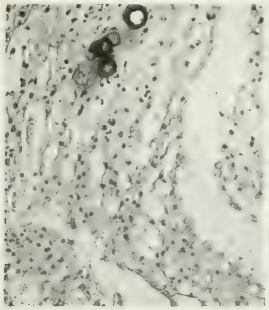

Fig. 7.

Fig. 7. Myxo-osteochondrosarcoma; stellate cells and area of cartilage. (×100.)

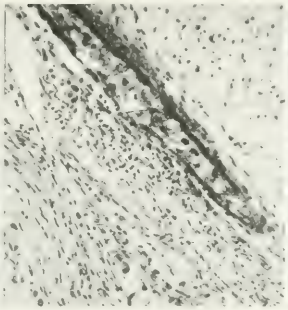

Fig. 8.

Fig. 8. From Figure 7. Area of bone formation. (×100.)

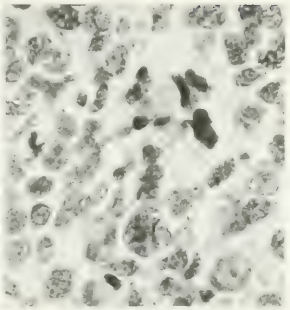

Fig. 9.

Fig. 9. Giant-cell sarcoma. (×500.)

cell sarcoma. These cells are large and contain several nuclei, which tend to arrange themselves together in the middle of the cell. The cytoplasm is opaque and may contain fat vacuoles or erythrocytes. Spindle-cells make up the bulk of these tumors, which are usually very vascular.

TREATMENT

The results of treatment of retroperitoneal sarcomata have been most unsatisfactory, and the prognosis is unfavorable. Potassium iodide has been given internally, but without appreciable benefit. Coley's serum seems to have been of value in many cases as a palliative measure. Surgical removal has been the treatment of choice for years, but it is too often hampered by the location, size, infiltration, vascularity, and adherence to vital structures, preventing complete removal. The condition of 20 of the 27 patients of the series operated on was found inoperable at the time of exploration. Seven tumors were enucleated or removed as thoroughly as possible; the tumor recurred in five instances; one patient died the day after operation; further data from the seventh could not be obtained.

The combination of radium and roentgen-ray treatment afforded excellent results in some of the cases. Several patients with both primary and secondary retroperitoneal sarcomata are now undergoing this type of treatment at the Clinic. The mass has entirely disappeared in several instances; the patients have gained weight and strength, and are able to carry on their work. It is too early to claim permanent cures in such conditions, but even if the great improvement is only temporary, it is well worth while, and achieves more than any previous treatment. If retroperitoneal sarcoma is suspected, a two weeks' course of radium and roentgen-ray will be of great aid as a diagnostic measure. If the tumor is sarcoma, an appreciable diminution in size will be noted. If it is not sarcoma, no damage has been done, and the mass may be explored. In this manner many patients may be saved the pain and expense of a fruitless operation, and receive the benefit of the best treatment now at our command.

SUMMARY

1. Retroperitoneal sarcomata are seen so often that they should be constantly kept in mind in the diagnoses of abdominal disorders.

2. Trauma is apparently not a factor in the cause of retroperitoneal sarcoma.

3. Metastasis occurs in about 33 per cent of cases; it is most often found in the liver and lungs.

4. The most characteristic physical finding is the colon in a groove on the anterior surface of the tumor.

STUDY OF TWENTY-EIGHT CASES OF PRIMARY RETROPERITONEAL SARCOMA AT MAYO CLINIC

Case, date	Sex, age	Duration of symptoms	Date of operation	Findings at operation	Pathological diagnosis	After-course
A[illegible] 4-[illegible]-10	M. 40	[illegible] weeks	4-27-10	Retroperitoneal sarcoma, 12 by 12 by 15 cm., originating in inner layer of mesosigmoid	Fibrosarcoma	Death from recurrence October, 1911
A[illegible]7028 5-14-10	M. [illegible]	[illegible] months	5-21-10	Inoperable, retroperitoneal sarcoma involving lymph nodes	Lymphosarcoma	Death October, 1910
A69460 6-20-12	F. 6	6 months			Giant-cell sarcoma (Fig. 3)	Unknown
A[illegible] 7-23-12	M. 54	Uncertain	8-2-12	Inoperable, retroperitoneal sarcoma at head of pancreas under middle part of duodenum and near hepatic flexure; adherent to liver	Oval and spindle-cell sarcoma	Death February 22, 1914
A[illegible]1 1-10-14	M. 19	4 months	1-21-14	Inoperable retroperitoneal tumor in left iliac fossa with erosion of inner surface of ilium	Lymphosarcoma	Death May 19, 1914
A[illegible]025 2-21-14	M. 29	3 months	2-25-14	Retroperitoneal sarcoma, 2 by 4 by 9 cm., in region of tail of pancreas	Small and medium round-cell sarcoma	Metastatic nodule behind ear; death from recurrence April 19, 1914
A[illegible]0170 4-20-15	M. 4	10 months	4-23-15	Inoperable retroperitoneal sarcoma, 15 by 7.5 cm. with metastasis to glands along aorta	Lymphosarcoma (Fig. 1)	Death August 6, 1915
A[illegible]0292 5-6-15	M. [illegible]	2 weeks	11-12-15	Inoperable sarcoma in lower part of abdomen pushing mesentery of small intestine forward	Small spindle-cell sarcoma	Unknown
A[illegible]7340 4-28-17	M. [illegible]	1 year	5-4-17	Inoperable retroperitoneal sarcoma in region of right flank	Fibromyxosarcoma	Unknown
A[illegible]7404 10-2-16	M. 57	1 year	10-6-16	Inoperable tumor filling pelvis and lifting bladder into abdomen and crowding sigmoid behind it	Spindle-cell myxosarcoma	Unknown
A[illegible]7418 10-5-16	M. 45	[illegible] years	10-17-16	Inoperable retroperitoneal sarcoma extending from diaphragm almost to pelvic brim, displacing large vessels to right, adherent to spleen	Lymphosarcoma	Death, November, 1916
A[illegible]7829 5-9-17	M. [illegible]	[illegible] years	5-24-17	Tumor 20 cm. in diameter growing from sacrum, internal surface of ilium, and lower lumbar vertebrae with metastasis to both lungs	Fibrosarcoma	Death March 25, 1917
A[illegible]94.02	M. [illegible]	10 months	5-21-17	Inoperable retroperitoneal sarcoma with metastatic nodules in the liver	Mixed round-cell and spindle-cell sarcoma (Fig. 6)	Death November, 1917
A107918 6-15-17	M. 62	1 year	6-25-17	Inoperable retroperitoneal sarcoma, 20 cm. in diameter, originating in right iliac fossa and extending upward; dense adhesions to peritoneum	Mixed-cell sarcoma	Death December 25, 1917
A[illegible]1215 7-17-17	F. 59	5 months	7-24-17	Inoperable retroperitoneal sarcoma attached to bladder and several loops of small intestine and colon	Spindle-cell sarcoma (Fig. 2)	Death December 16, 1917
A227733 4-[illegible]-18	[illegible]	4½ weeks	4-25-18	Inoperable retroperitoneal sarcoma behind stomach and colon	Lymphosarcoma	Death September 2, 1918
A[illegible]4 4-27-18	M. 61	4 weeks	[illegible]-4-18	Degenerating retroperitoneal lipoma attached to lower pole of right kidney, weighing 3900 gm., occupying entire right side and extending to brim of pelvis on left (Fig. 4)	Myxosarcoma (Fig. 5)	Unknown
A[illegible]1 5-2-18	M. 57	1 year	5-[illegible]-18	Inoperable retroperitoneal tumor, 30 cm. in diameter with broad adhesions to all surrounding tissues	Lymphosarcoma	Tumor greatly enlarged; patient has lost greatly in weight and strength
A[illegible] [illegible]-[illegible]-18	M. [illegible]	[illegible] weeks	[illegible]-[illegible]-18	Inoperable retroperitoneal sarcoma behind cæcum and mesentery of small intestine	Lymphosarcoma	Patient received roentgen-ray for several weeks. In February, 1919, had gained 3 pounds; was without pain and was working
A[illegible]14 11-11-18	M. [illegible]	1 year	11-18-18	Retroperitoneal sarcoma attached to right kidney extending from the diaphragm to brim of pelvis	Fibrosarcoma	Patient received roentgen-ray, radium, and Coley's serum. January 6, 1919, he had gained 7½ pounds and was in good general condition.

STUDY OF TWENTY-EIGHT CASES OF PRIMARY RETROPERITONEAL SARCOMA AT MAYO CLINIC—CONTINUED

Case, date	Sex, age	Duration of symptoms	Date of operation	Findings at operation	Pathological diagnosis	After-course
A250014 11-11-18	M. 32	1 year	6-13-20	Recurrent retroperitoneal sarcoma, weighing 350 gm., with metastatic nodules in liver and retroperitoneal tissue below the diaphragm.	Fibrosarcoma (Fig. 3)	Death, time uncertain
A251374 11-21-18	M. 42	1 year	12-3-18	Inoperable retroperitoneal sarcoma filling entire right side and extending across median line	Spindle-cell sarcoma	Death a few months later
A275504 6-10-19	F. 25	11 months	6-24-19	Inoperable tumor situated retroperitoneally filling entire abdomen	Fibrosarcoma	Death November 13, 1920
A291541 8-1-19	M. 48	1½ months	10-13-19	Two retroperitoneal tumors on left side; one 30 by 15 cm.	Myxofibrolipoma	Patient returned to Clinic August 9, 1921, with palpable mass in abdomen
		6 weeks	8-15-21	Recurrent retroperitoneal tumor 20 cm. in diameter below pole of left kidney	Myxofibrosarcoma	Unknown
A295043 10-30-19	M. 41	10 months	11-5-19	Tumor, 12 cm. in diameter, filled with gelatinous bloody material. The sacrum was honey-combed	Myxochondroosteo-sarcoma (Figs. 7 and 8)	Recurrence July, 1920
A297816 11-24-19	M. 3	6 weeks	12-5-19	A hard tumor, 8 cm. in diameter, behind the bladder in the region of the prostate	Myxosarcoma	Death from recurrence March 18, 1920
A304223 1-26-20	M. 26	3 months	1-31-20	Inoperable tumor almost filling the pelvis adherent to loops of intestine; involvement of inguinal glands	Lymphosarcoma	Patient in good general condition
A319811 6-14-20	F. 39	4 months	6-23-20	Inoperable apparently retroperitoneal tumor behind umbilicus with metastasis to the inguinal glands.	Lymphosarcoma	November 30, 1920, patient was in good general condition
A342301 11-30-20	M. 42	5 months			Lymphosarcoma	January 4, 1921, death from bronchopneumonia. Necropsy revealed retroperitoneal lymphosarcoma with metastasis to the great omentum and mesenteric lymph nodes

5. The small round-cell sarcoma or lymphosarcoma is the most common and most malignant type.

6. The prognosis is always unfavorable. A combination of radium and roentgen-ray seems to be the most satisfactory treatment thus far instituted.

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THE CLINICAL PICTURE OF DILATED DUCTS BENEATH THE NIPPLE FREQUENTLY TO BE PALPATED AS A DOUGHY WORM-LIKE MASS—THE VARICOCELE TUMOR OF THE BREAST

By JOSEPH COLT BLOODGOOD, M.D., F.A.C.S., Baltimore

SURGEONS must quickly learn that the various benign and malignant lesions of the breast are associated with different clinical pictures and that the same pathological process may give rise to different clinical appearances varying from distinctly benign to evidently malignant.

The gross and microscopic pathology of various pathological conditions of the breast has been pretty well established, but in recent literature one can find little help in the interpretation of the varying clinical pictures, and I propose to attempt from time to time to describe them with the hope that these descriptions will be helpful to those responsible for the diagnosis before operation, and during operation when an exploratory incision is indicated.

CLINICAL PICTURE

We cannot expect much help from the older textbooks and monographs, nor even from more recent textbooks and contributions. This is due to the fact that until recently the majority of women feeling a lump in the breast has delayed. During this delay, I have evidence to show that many lumps, especially those due to chronic cystic mastitis, disappear spontaneously. The malignant tumor rapidly assumed the clinical picture of cancer due to the retraction of the nipple, the involvement of the skin, and even ulceration of both, while the distinctly benign remained an encapsulated tumor without changes in the skin or nipple.

Benign lesions of the female breast for which operation is not indicated. In 1922 in a paper with the above title[1] I recorded the fact that in the last 100 women whom I had examined, in over 50 per cent the clinical picture was such that operation was postponed and, in the majority of cases, not performed. Of the remaining 50 per cent more than 25 per cent were benign.

[illegible]

When we compare these figures with the first decade (to 1900), it was found that in less than 2 per cent was operation not indicated and in about 10 per cent only was the tumor benign.

In December, 1921, I found that I had collected 267 histories of women in which operation was considered not indicated. In 64 of these, as the patient had pain and 14 of them had felt a tumor, careful and often repeated palpation was necessary before the conclusion was made that neither breast contained a lump.

In 50 cases the breast was the seat of multiple indefinite lumps probably due to some form of chronic cystic mastitis, and the absence of a definite lump precluded any operative intervention.

I feel convinced that every member of the medical profession called upon to examine the breast, either from the standpoint of the clinician only, or from the attitude of both clinician and operator, will see more and more of this type of breast lesion and all of them will need some definite data based upon the study of a large group of cases which should be helpful to them in making a decision.

Chronic cystic mastitis. In the *Archives of Surgery* for November, 1921 (iii, 445–542), I described in detail the gross and microscopic pathology of chronic cystic mastitis, and reproduced 91 illustrations, gross and microscopic. This report was based upon the study of 350 cases.

On page 450 of that article the diffuse dilatation of the ducts beneath the nipple is described as follows:

"*BB-13-6. The diffuse dilatation of the ducts chiefly in the nipple zone, rarely in the breast outside this zone.* The characteristic clinical picture when the dilated ducts are situated in the nipple zone is the palpation of a doughy, worm-like mass beneath the

nipple. When explored, one can recognize large and small dilated ducts with distinct wall, containing brown, green, milky, or cream-like material, of various degrees of viscosity and consistency. The contents, when expressed, appear as soft, worm-like masses exposing the distinct smooth wall of the duct—a gross picture, if carefully inspected, different from that of the comedo-adenoma.

"When it occurs in a zone of breast outside the nipple area it feels like diffuse mastitis, but has not the distinct edge or border of the diffuse non-encapsulated cystic adenoma."

On page 500 of the *Archives of Surgery* (loc. cit.) I report in detail a number of these cases of which at that time there were 22, and describe the different clinical pictures.

Even at the time of the writing of this article (July, 1921) I was rather of the opinion that operation was *not* indicated if the tumor beneath the nipple palpated distinctly like a doughy, worm-like mass, and record one observation (page 507) in which operation was not done, and the tumor disappeared. Since then I find records of 7 additional cases in which I have deferred operation and in which the lesion has practically disappeared.

The varying clinical picture associated with diffuse dilatation of the ducts in the nipple zone. This definite pathological entity can be classed as a part of chronic cystic mastitis. It may be present and give no evidence of its presence by either pain, discharge from the nipple, retraction of the nipple, or a palpable tumor. When breasts are removed for benign or malignant tumors situated outside the nipple zone and a section is made through the breast and nipple, one may find beneath the nipple these dilated ducts with their characteristic contents (Fig. 1). In the *Archives of Surgery* (loc. cit.) in describing the excision of a blue-domed cyst I have called attention to the quite common exposure of these dilated ducts beneath the nipple divided when one cuts the breast between the nipple zone and the blue-domed cyst.

I have carefully studied all our cases of cancer of the breast and I am unable to demonstrate any relation between malignancy and the dilatation of the ducts beneath the nipple. For this reason, if there is nothing to be made out but the palpation of a single or multiple worm-like, doughy mass beneath one or both nipples, with or without discharge from the nipple, there is no indication for operation.

Unfortunately this pathological entity—dilatation of the ducts beneath the nipple—may be associated with palpable tumors of a different character from that described as typical and, in addition, there may be retraction or fixation of the nipple, dimpling or fixation of the skin. In some instances the clinical picture so closely resembles cancer that it seems only proper in this group to perform the complete operation for cancer without exploration. In a few instances the re-active mastitis (periductal) is so marked that the tumor beneath the nipple not only has the induration suggestive of malignancy, but when it is explored, cuts and looks like cancer, as the inflammatory tissue has obliterated and emptied the ducts. A few cases have assumed the picture of an abscess beneath the nipple and areola, due to infection of a dilated duct, and in a very few cases the area has been outside the nipple zone, and in these the clinical picture has closely resembled cancer.

The clinical pictures recorded in cases of diffuse dilatation of the ducts situated beneath the nipple (26 cases). I will not describe the pathology as it is pictured in detail, with illustrations in the *Archives of Surgery* (loc. cit.). Fourteen may be classed as clinically benign, 9 as malignant, and in 3 the palpable tumor resembled an abscess.

1. The tumor palpated like a single tortuous worm or a bunch of worms beneath the nipple (the *varicocele* tumor of the breast)—11 cases; 7 unilateral, 4 bilateral. Of the 7 unilateral cases, 2 under observation became bilateral.

2. The tumor palpated somewhat like a cyst beneath the nipple—3 cases, all unilateral.

In these 14 cases there was no evidence suggestive of malignancy. In 9 cases there was a discharge from the nipple, in 3 no discharge; in the remainder there is no note on discharge from the nipple.

3. The tumor palpates like a worm-like mass, but, in addition, there is slight induration suggestive of malignancy (1 case) or a retracted nipple (1 case).

4. The tumor is described as a mass beneath the nipple, and the nipple is either retracted or fixed; the areola either dimpled or fixed. In these 4 cases the operator performed the complete operation without exploratory incision in 3 cases, and after an exploratory incision in one.

5. The palpable tumor is an indefinite area of induration beneath the nipple with slight retraction of the nipple. Here there are two cases, both bilateral.

6. Retraction of the nipple only; no discharge from the nipple, 1 case.

7. The tumor resembles an abscess with the red and infiltrated skin and the small, doughy, fluctuating mass, 3 cases.

8. In this group the tumor is palpated outside the nipple zone, 3 cases. One of these has been previously described in the *Archives of Surgery* (loc. cit., Fig. 19, Path. No. 21192, p. 464).

Description of the clinical picture in detail. As I have had a large experience in discussing the clinical examination and diagnosis of breast lesions, both before audiences of surgeons and physicians and in personal conversation and correspondence, I am convinced that, to convey the message properly, one must give in detail the actual description of what was seen on inspection and what was felt on palpation. Fortunately, I am able in this paper not only to record my own observations, but to give the written description of other operators.

Group 1. The varicocele tumor of the breast. No operation 7 cases.

J.C.B. No. 8898. Observed in 1919. This patient noticed a blue area beneath the areola near the nipple and then thought she felt a little hardening beneath this point. There was no discharge from the nipple. It has been present a few weeks. At my examination I could see a little bluish spot beneath the areola of the right nipple and could palpate a tortuous, doughy, worm-like tumor, perhaps 1 centimeter in length. When the breast was pushed forward there appeared to be slight dimpling in the blue area over the lump. My experience has taught me that slight dimpling in the areola has not the significance of malignancy as when it is present over a lump outside this area. This patient has been observed now (September, 1922) 3 years and 10 months. There was frequently a little pain and tenderness in this lump and it gradually became less distinct. During the interval there were recurrences of pain and tenderness, an increase in the size of the lump, and a similar palpable lesion in the other breast, without discharge from either nipple. The blue area and the palpable lumps have disappeared.

J.C.B. No. 9105. Observed in 1919. The patient had observed a redness of the areola of the left breast 3 weeks ago. It disappeared in 2 days; then she felt an indefinite lump which had distinctly varied in size. I could palpate a number of doughy, worm-like masses; there was no discharge from the nipple. The condition rapidly disappeared, and the patient reported no return after 3½ years.

J.C.B. No. 11987. Dr. J. L. Campbell, of Atlanta, Georgia, made the following report to me in July, 1922: "The patient has observed a brownish discharge from the right nipple for 6 weeks, and some pain in the breast." On palpation, Dr. Campbell writes: "Immediately beneath the areola there is a tortuous, worm-like mass 3 centimeters long and 3 millimeters wide. . . . . Gives a sensation to the fingers as if filled with varicose veins. On pressure there is some bloody discharge from the nipple." There is no report since this first note. I advised against operation.

J.C.B. No. 12004. This patient has observed pain and tenderness in the left breast for 3 years, chiefly before menstruation. Recently the patient thought she felt a lump in the nipple zone, and there is tenderness there. There has been no discharge from the nipple. I could palpate a single, tortuous, doughy, worm-like mass about 1 centimeter in diameter, but could express nothing from the nipple. Operation was not advised, and there has been no report since examination in July, 1922.

J.C.B. 8598. Observed in July, 1918. In this patient the left breast had been operated on for cancer 14 months before. The sections of the tumor sent to me at that time showed no evidence of carcinoma but dilatation of the ducts in the nipple zone with periductal mastitis. The patient was then referred to me, because she had observed a milk-like discharge from the left breast of some 6 months duration. At my examination in July, 1918, I could palpate no tumor, but could express milk-like material from the nipple. Operation was advised against, because of the definite microscopic evidence that the tumor in the right breast was not cancer. The patient returned in 1 year, because she and her physician had felt a lump near the nipple; the discharge had disappeared. At my examination there was an indistinct, single, doughy, worm-like mass 1 centimeter long beneath the nipple, and nothing could be expressed from the nipple. I am informed 3 years later that the tumor has disappeared.

J.C.B. No. 10524. This patient had had pain, tenderness, and a lump beneath right nipple for 4

months. The lump had been felt by her physician, Dr. Wertz, of Hagerstown, Maryland. At my examination I could palpate beneath both nipples the typical varicocele tumor. The patient was unaware of the condition on the left side, and there was no pain or tenderness on the left side, and nothing could be expressed from either nipple. At the second examination 7 weeks later both tumors were less distinct, and the pain and tenderness in the right breast had diminished. It is now more than 1 year since the last examination and as both Dr. Wertz and the patient promised to report I infer that the condition is improving or disappearing.

Pathol. No. 12105. I was asked to see this patient by Dr. R. C. Coffey of Portland, Oregon, in July, 1922. He had accurately described the condition, favored a benign lesion, and advised against operation. The patient had observed a small lump in the area of the areola for 1 year. It has become larger and painful 2 months, and when Dr. Coffey first examined the patient 1 week ago, he could express from the nipple thick, grumous, brownish material which varied in color. At my examination I found what Dr. Coffey had found in the right breast—a soft doughy nodule the size of a ten-cent piece which, when pressed upon, was tender and brownish material came from the nipple. I also found a similar nodule beneath the left nipple, but this was not tender and nothing could be expressed from the nipple. I advised against operation unless, under observation, the tumor did not disappear. It is now 6 weeks, and Dr. Coffey writes that the condition remains the same.

I have, therefore, summarized 7 cases of which 4 at the onset were unilateral and 3 bilateral. Under observation 1 has become bilateral. None were subjected to operation.

CLINICALLY BENIGN TUMORS

Group 1. The varicocele tumor of the breast, clinically benign, subjected to operation—4 cases.

Path. No. 19767. Observed in 1916. The patient had observed a brownish discharge from the right nipple and had felt an indefinite tumor in the nipple area, and there had been pain and tenderness. At that time, although I did not think that the condition was malignant, I removed the breast. For the gross pathological picture see *Archives of Surgery* (loc. cit., Fig. 16, p. 461). There has been no trouble in the remaining breast now, 6 years since the operation. If I had examined this patient recently, I would have advised against operation.

Path. No. 19902. Observed in 1919. This patient had observed pain and tenderness in both breasts for 1 year. The breasts were carefully examined by Dr. Porter, of Roland Park, Maryland, with negative findings 8 months ago. Three days ago she suddenly felt a lump beneath the right nipple; the lump was tender, and she observed a drop of brownish material. At my examination I could palpate beneath the right nipple one small, doughy, worm-like mass, and could express a drop of brownish material. I could palpate nothing in the other breast. Although I considered the condition benign, I explored, found the tumor to be dilated ducts surrounded by other dilated ducts filled with brownish material. I removed the breast, which I would not do today.

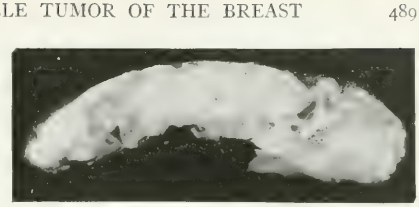

Fig. 1. Gross section through nipple and breast. Beneath nipple great dilatation of ducts filled with greenish-brown grumous material. The cancer tumor in the periphery to the left. In this case there was no palpable tumor in the nipple area and no discharge from the nipple. Path. No. 14924.

It is now 6 years, and no trouble has developed in the remaining breast.

Path. No. 24560. Observed in 1919. This patient was referred to me by Dr. Ries, of Baltimore, because of a milk-like discharge from the right nipple and worm-like masses beneath the nipple. It is interesting to note that the patient ceased nursing a child 7 months ago, and she has observed a lump and a milky discharge since. At my examination the tumor felt like a varicocele. There was no induration or infiltration, no retraction or fixation of the nipple or areola. As the condition did not disappear under observation, 2 months later I explored the zone, found the dilated ducts and for the first time confined the operation to the excision of the affected zone only. The gross pathology is pictured in the *Archives of Surgery* (loc. cit., Fig. 17, p. 462). This patient has now been observed more than 2 years. A few months after operation a similar condition developed beneath the nipple of the other breast which disappeared under observation.

This is the only case in which dilatation of the duct beneath the nipple has had such a close relation to lactation. The contents of the dilated duct was not that of galactocele, and the surrounding breast showed no lactation hypertrophy.

Path. No. 27114. Observed in 1920. It is interesting to note that the lesion in this case had previously been diagnosed Paget's disease, because the discharge from the nipple had produced an irritation.

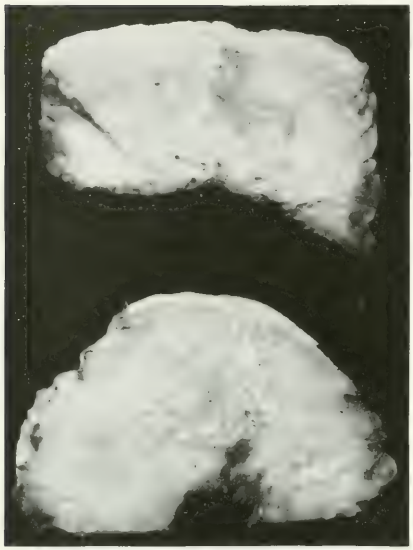

Fig. 2. Section through nipple and breast. Note dilated duct filled with milk-like material; surrounding breast, fatty and senile. Path. No. 19994.

When I examined the patient this irritation had disappeared. The discharge had been observed 2 months ago; it was yellowish in color and has not been observed recently. I could palpate beneath the left nipple the typical varicocele tumor. The nipple was a little pulled in, but not fixed, and the patient was positive that this slight retraction had been present a number of years since the previous lactation. In this case I explored, found the dilated duct, and removed the affected zone beneath the nipple. The gross pathology is illustrated in the *Archives of Surgery* (loc. cit., Fig. 18, p. 663). No trouble has developed in either breast now, almost 2 years since operation.

Group 2. The tumor palpates somewhat like a cyst beneath the nipple—3 cases, 2 unilateral and clinically benign.

Path. No. 19994. This patient has had pain in the left breast for seven days and has felt the lump one day. At the examination by me the tumor, the size of a silver dollar, occupies the center of the breast; it has the tenseness and spherical shape of a cyst. The nipple and skin are normal. From the nipple I could express yellow, creamy material. The same material could be expressed from the right nipple, but in this breast I could not palpate a tumor. I was inclined to the view that it was benign, but felt that it should be explored, as medullary carcinoma now and then gives this sensation to palpation. However, if the patient was correct in her statement as to the duration, malignancy could practically be excluded. I have observed blue-domed cysts of this size of 24 hours' duration, but until this case not one due to dilatation of the ducts.

At the operation I explored the tumor in the left breast, and found it to be a cyst filled with thick, cream-like material; the cyst immediately collapsed. All the ducts beneath the nipple were dilated giving the picture of a diffuse galactocele (Fig. 2) (Path. No. 19994, gross). The microscopic picture of the diffuse dilatation of the ducts has been reproduced in the *Archives of Surgery* (loc. cit., Fig. 49, p. 492).

At this time I was not so certain that dilatation of the ducts might not now and then be a precancerous lesion. For this reason I removed the other breast also. Although there was no palpable tumor in this breast, the ducts showed dilatation with thick, cream-like contents.

Relation to galactocele. I have already mentioned one observation in which the dilatation of the ducts filled with milk-like material seemed to date back to a lactation 7 months before. In this case in which the gross appearance was almost identical with that of galactocele, the patient, although married, had had no pregnancies nor miscarriages. The patient is well 6 years after operation.

Path. No. 22575. The specimen from this case was received in the laboratory unopened. The operator had removed the breast only. On palpation there was a cystic lump the size of a fifty-cent piece beneath the nipple which on section proved to be a dilated duct filled with brownish, grumous material surrounded by other dilated ducts.

Path. No. 25186. When this specimen was received in the laboratory, I was informed by Dr. Finney, who had performed the operation, that he had felt a cystic nodule the size of a ten-cent piece beneath a normal nipple and areola. The lump had been observed 2 months, 1 month after trauma. When Dr. Finney explored on the diagnosis of a benign tumor in 1919, he found many dilated ducts filled with thick greenish fluid, and a small cyst with the same contents. Apparently this was the only lesion to be palpated, and demonstrates that beneath the nipple, there may be many dilated ducts filled with material which are not felt and nothing is expressed from the nipple. Figure 3 is a section through the nipple area of the hardened breast. It shows the larger duct and the smaller ducts with their contents. This gross appearance is typical of the condition I am describing. The result in this case has not yet been ascertained.

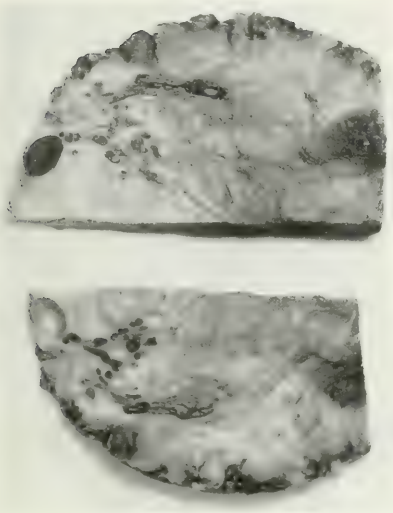

Fig. 3. Section through breast in nipple zone, showing the dilated duct filled with different colored material. Only the larger one to the left was palpable clinically. Path. No. 25186.

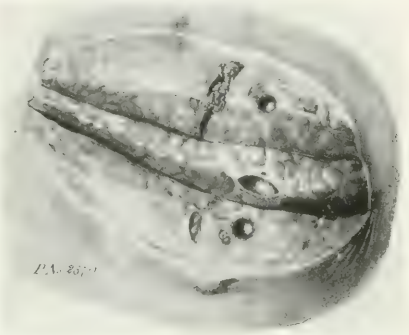

Fig. 4. Photograph of original painting. Note the worm-like mass in the dilated duct near the nipple which could be palpated, and the cyst also to be felt clinically. This is the first picture on record of this type (1899). (From Dr. Halsted's collection.) Path. No. 2879.

CLINICALLY MALIGNANT TUMORS

Group 3. The tumor palpates like a worm-like mass, but there is slight induration suggestive of malignancy, or a retracted nipple (2 cases).

Path. No. 2879. Observed in 1899. I mentioned this case in the *Archives of Surgery* (loc. cit., p. 501) and it represents the first observation of this peculiar worm-like tumor due to dilatation of the ducts. In addition to a doughy, worm-like mass beneath the nipple, there was a second tumor palpating like a cyst, and entirely surrounded by slight infiltration. From the nipple there could be expressed sebaceous-like material. Dr. Halsted, who performed the operation, was inclined to the diagnosis of a benign lesion, and when he explored there was exposed one dilated duct filled with sebaceous material and one small cyst (Fig. 4). Although the operator favored a benign lesion he gave the patient the benefit of the doubt and performed the complete operation. No evidence of malignancy was found in the microscopic section from the breast and the glands. This patient remained well many years.

Path. No. 24633. I described the tumor in this case in 1919 as follows: "The lump beneath the right nipple feels like a varicocele, but there is infiltration of the tissue about it suggesting malignancy. There is no retraction or fixation of the nipple and no discharge from the nipple. When I explored the tumor it looked and cut like cancer, and the complete operation was performed. On examining the breast after operation I found numerous dilated ducts filled with grumous material in a zone beyond that exposed by the exploratory incision. I had exposed at this incision an inflammatory area with marked periductal mastitis which had compressed and almost obliterated the duct. The microscopic section showed no evidence of cancer. This patient has been lost track of.

Group 4. The tumor is described at a mass beneath the nipple, and the nipple is either retracted or fixed (4 cases).

I examined only the specimens in these 4 cases and must therefore give the clinical picture as recorded in the notes sent me with the specimens.

Path. No. 15988. Observed in 1914. Dr. McClure, then the resident surgeon of Johns Hopkins Hospital, performed the complete operation for cancer, because the clinical signs of malignancy were definite. The tumor was an irregular mass the size of an egg beneath the nipple; the nipple and areola were fixed. These must be looked upon as definite signs of cancer. Later, when the tumor was sectioned, it was found to be composed of tortuous dilated ducts filled with greenish, colloid material, with much periductal inflammatory reaction. Microscopic sections showed no evidence of cancer in the breast and glands. The patient was well 6 years later.

Path. No. 25612. Dr. George R. White of Savannah, Georgia, who performed the complete operation in this case described the tumor as "a very hard nodule the size of an English walnut beneath the left nipple; nipple attached but not retracted; creamy-brown discharge from nipple. Other breast normal."

This patient is well 2 years after operation.

Path. No. 28170. My colleague Dr. John M. T. Finney, wrote me about this case as follows: "Woman, age 69; unmarried; pain and small lump 4 weeks. Examination showed breasts small and atrophic; just below the left nipple was a small, rather firm lump the size of a filbert; slight retraction with dimpling of skin was present over this lump; no retraction of the nipple; the lump did not seem to be definitely circumscribed; it was rather elastic. Diagnosis uncertain between a localized area of cystic mastitis and early carcinoma. At the exploratory incision into the lump dilated ducts full of brownish fluid were found; no evidence of cancer. Diagnosis: chronic mastitis." Dr. Finney removed the breast and the axillary glands. The microscopic sections showed no evidence of cancer in the breast and glands.

Path. No. 30842. This specimen was received from Dr. S. W. Budd of Richmond, Virginia, with the following note: "Lump in left breast the size of a duck's egg; hard and infiltrating the surrounding breast. It had been present 4 weeks." The complete operation was performed by Dr. Blair, of Richmond. The gross is described as follows: "In the center of the tumor there is a cavity containing yellowish material. The sections from the tumor and glands show no cancer."

These four cases show that dilatation of the ducts with periductal inflammation may give a clinical picture which cannot be differentiated from cancer.

Group 5. The palpable tumor is an indefinite area of induration beneath the nipple with slight retraction of the nipple (2 cases, both bilateral).

Path. No. 16370. Observed in 1914. This patient consulted me, because she had pain in both breasts. Both nipples had always been congenitally depressed, and for this reason the patient was unable to nurse her children. I describe then in my notes the lumpy breast, or the multiple indefinite lumps in both breasts, as follows: "Both nipples retracted; both breasts lumpy and pendulous; indurated areas chiefly beneath the nipples; sufficiently suspicious to justify the removal of both breasts." Apparently I was impressed with the induration in the breasts beneath the nipple and the retraction of the nipple more than could be explained by congenital depression. I removed both breasts, and found only the dilatation of the ducts beneath the nipples, not very marked, and throughout the breasts minute cysts and adenomatous areas. I am inclined to the opinion that if I were to examine this patient today, I would be able to conclude that she simply had lumpy breasts due a chronic, diffuse cystic mastitis, and that the nipples were of the congenitally depressed type; that operation was not indicated. The microscopic study showed no evidence of cancer. The patient died 4 years later from influenzal-pneumonia during the epidemic.

Path. No. 19824. Observed in 1916. This patient first observed serum from the left nipple 11 months before examination, and there continued to be a discharge, watery and bloody. My note on the examination in 1916 reads as follows: "On pressure bloody serum from the left nipple; nothing to be expressed from the right nipple. Both breasts are lumpy; both nipples dimpled when the breasts are pushed forward. Definite induration in the nipple zone of the breasts; the nipples seem a little thick. The patient is 72 years of age. I removed both breasts.

I am inclined to think should I examine this patient now, I would place her record in the group of discharge from the nipple and bilateral lumpy breasts, and advise against operation. I have never seen carcinoma to begin simultaneously in both breasts. Discharge from the nipple is rare in carcinoma. The probabilities are that I exaggerated the induration beneath the nipple.

Group 6, there is retraction of the nipple (1 case).

Path. No. 14135. Observed in 1913. This patient age 65, had observed pulling in of the nipple for 10 months. Nothing was to be made out on examination, except a distinctly and completely retracted nipple. I removed the breast and found nothing but a few dilated ducts beneath the nipple. This patient died of other causes 1 year later.

Group 7 shows clinically an abscess.

Path. No. 20117. Observed in 1916. Dr. Dandy, then resident surgeon of Johns Hopkins Hospital, asked me to see this patient, and we made the diagnosis of mastitis in diffuse dilatation of the ducts beneath nipple. The breast was removed. On examination, both breasts were large and pendulous. In the right breast beneath the nipple there were two doughy, worm-like masses. The skin of the left areola and a small zone beyond was red and indurated—the picture of mastitis—and beneath the nipple and areola a doughy mass. There was no discharge from the nipple. The patient, age 48, had observed trouble in the left breast for 1 year. There has been redness and pain, and what she described as pimples on the areola. The present attack which was more marked than any previous be-

gan three days ago. The gross pathology showed dilated ducts beneath the nipple with periductal mastitis and a small abscess. The microscopic sections showed no evidence of cancer. There maining breast has given no trouble in the 6 years since operation.

The clinical picture here is distinctly that of an inflammatory lesion. Cancer never assumes such a picture in the first few days. The proper treatment today would be ice, incision if the inflammatory process did not subside, and if there was healing without residual induration, further operation would not be indicated.

Path. No. 27935. The history and tissue was sent to me by Dr. Loos of Bay City, Texas, in 1921, and I have reported this observation, with illustrations in the *Archives of Surgery* (loc. cit., Fig. 20, p. 405). Dr. Loos describes the onset of the trouble 3 weeks before his examination, as an acute swelling of the breast with pain. These symptoms disappeared in 1 week, and recurred. On examination Dr. Loos describes the mass as of the size of a silver dollar in the nipple zone; the skin was red; the mass fluctuated; pus could be expressed from the nipple; the glands in the axilla were palpable; the nipple seemed slightly retracted. Although the operator was inclined to the diagnosis of mastitis, he considered it safer to perform the complete operation for cancer. On examining the breast after operation his conclusion was that the lesion was mastitis and not cancer. Microscopic sections of the tumor and glands show no cancer. The patient has remained well more than 1 year since the operation.

Path. No. 28669. This breast was sent to the laboratory with the clinical and gross diagnosis of tuberculosis. At the examination of the breast before operation, it was noted that there was a small mass of induration beneath the nipple and that the skin was red. The patient, age 28, unmarried, had observed a lump near the nipple for 2 years. The pain and redness were recent. The microscopic sections show no evidence of tuberculosis; there are dilated ducts and periductal mastitis, and a small abscess.

Group 8. Tumor outside the nipple area (3 cases).

Path. No. 21192. Observed in 1917. I have described this unique case in the *Archives of Surgery* (loc. cit., Fig. 19). The picture was one of diffuse mastitis involving the outer hemisphere; acute in onset with pain and swelling of 10 days' duration.

In the *Boston Medical and Surgical Journal*, August 17, 1922, clxxxvii, p. 243, I described breast lesions which have the clinical picture of a diffuse mastitis. The pathological processes which may give rise to a diffuse infiltration of a zone, hemisphere, or the entire breast may be lactation mastitis, non-lactation mastitis, diffuse dilatation of the ducts with periductal mastitis, tubercular mastitis, diffuse chronic cystic mastitis (the "shotty" breast), comedo-adenoma with and without cancer, and carcinoma mastitis. In addition to what has been published in the *Boston Medical and Surgical Journal*, there appears in the *Southern Medical Journal* for December, 1922, a contribution to diffuse mastitis of the breast, and its recognition and treatment.

Of the two remaining cases in this group I have the specimens and short clinical descriptions.

Path. No. 13864. Observed by Dr. Egdahl in 1916. He writes that the lump in the breast is in the upper quadrant; the nipple is distinctly retracted and fixed. Naturally, he did the complete operation for cancer. The patient is well 8 years later. The gross and microscopic study showed that in the tumor area there were chiefly dilated ducts which were also present beneath the nipple.

Path. No. 23024. This specimen was sent to the laboratory by Dr. Barrett, of Baltimore, in 1918, with the information that the complete operation had been performed, because of a tumor in the upper and outer quadrant of the breast the size of a ten-cent piece over which the skin was adherent and dimpled. In the specimen we found in the tumor area a dilated duct filled with brown, grumous material. Beneath the nipple the duct was slightly dilated. The sections showed no evidence of cancer. This patient is reported well 2 years later.

ETIOLOGY

Relation of chronic dilatation of the ducts to age, lactation, and menopause. Like any type of chronic cystic mastitis, this lesion has been observed throughout adult life. On the whole this type of dilatation of the ducts is more common after the age of 45, and the patients are usually at the menopause, or have passed it. It has been observed in women who had never borne children, and in those who had lactated once or more without trouble. It impresses me as a lesion of the senile breast. *Trauma* is not prominent as an etiological factor.

As a rule the patients come quickly after the onset because of *pain* and *tenderness*, or discharge from the nipple. It may have an acute onset which may subside leaving only

the palpable worm-like tumor, or go on to abscess formation.

The most important point in its recognition is the palpation of one or more doughy, worm-like masses beneath the nipple. I think it may be correctly called the varicocele tumor of the breast.

This evidence seems to show that when the lesion can be recognized, operation is not indicated. When, however, there is a definite picture suggestive of malignancy, either one must explore or perform the complete operation for cancer without exploration.

DISCHARGE FROM THE NIPPLE

Dr. Clarence Cohn has gone over the record of every breast lesion in the laboratory to ascertain the significance of discharge from the nipple, and the following statement may be made from this evidence, some of which has previously been published:

A discharge from the nipple is, of itself, not an indication of a malignant tumor, and if palpation finds no tumor, operation is not indicated. We have records of 36 such cases.[1]

The discharge from the nipple is most frequently observed with the benign tumor—the cyst with intracystic papilloma. It is next most frequently observed in the dilatation of the ducts beneath the nipple. In less than 1 per cent of the cases has discharge from the nipple been the symptom of onset in a breast in which later a cancer developed.

When the discharge from the nipple has been bloody or serous, one usually finds that the tumor associated with it is an intracystic papilloma. When the discharge is thick, grumous, brown, green or yellow, one invariably finds dilatation of the ducts beneath the nipple without an intracystic papilloma.

As dilatation of the ducts with and without a papilloma containing almost any kind of secretion may be present in any breast without any clinical evidence of its presence, it would be natural to find a history of such a discharge or its presence at examination, in every type of breast lesion, whether benign or malignant, and this has been proved to be true. When these breasts are completely sectioned, we rarely fail to find the dilated duct, with or without papilloma.

Therefore, the diagnosis of a palpable tumor associated with a discharge from the nipple, must not be influenced much by this discharge. Yet, when the tumor is a worm-like mass beneath the nipple, it is very suggestive that the tumor is a benign dilatation of the duct. Again, when the tumor palpates like a cyst and, on pressing the tumor, blood or serum exudes from the nipple, this is very suggestive that the tumor is a benign intracystic papilloma.

PAGET'S DISEASE AND DISCHARGE FROM THE NIPPLE

As I have had two patients with discharge from the nipple which produced a slight eczema, and for this reason were diagnosed Paget's disease, I take this opportunity to emphasize again[2] that in Paget's disease there is no discharge from the nipple ducts; there may be weeping, even blood-tinged, after the ulceration has begun. But nothing can be expressed from the nipple.

CONCLUSIONS

In a series of articles I am attempting to describe the clinical picture of the breast lesions, especially those which are pretty typical of the pathological process.

In the *Archives of Surgery* (loc. cit.) and again in the *Journal of the American Medical Association* (loc. cit.), I called attention to the frequency of the multiple indefinite lumps in both breasts. This can be called the "lumpy" breast. When such lumpy breasts are unnecessarily removed, we find that each little area which had been palpated as an indefinite lump is due to increased adenomatous areas, or to one or more minute cysts, or dilated ducts. Operation is not indicated when palpation reveals a lumpy breast only. Then, both breasts may be filled with many definite cyst-like tumors. I am inclined to the view that Warren's term "cobblestone breast" is descriptive. When these breasts are unnecessarily removed the multiple tumors are usually found to be blue-domed cysts.

When a zone, or a quadrant, or a hemisphere, or the entire breast, is diffusely thickened, like the caked breast of mastitis, and the involved area has a distinct edge like the liver, and when it is picked up like a saucer from the chest wall and one can palpate numerous shot-like masses, we have a definite clinical picture which may be called a "shotty breast," and in my experience up to date, such a clinical picture has always been associated with the diffuse, chronic, cystic mastitis described in the *Archives of Surgery* under the Group BB-13-8, and is again discussed in the *Southern Medical Journal* (December, 1922).

When the diffuse area does not palpate like a shotty breast, but simply like the caked breast of mastitis, we can use the term *diffuse mastitis* and, as already has been mentioned, it may be either benign or malignant.

Then we have the distinct clinical entity which I have described in this paper, the *varicocele tumor* of the breast. Other types may be evolved as these investigations go on.

PSEUDOHERMAPHRODISM OR COMPLETE HYPOSPADIAS[1]

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COMPLETE HYPOSPADIAS

COMPARED with lesser degrees of hypospadias, hypospadias perinealis is by far the rarest form. Up to 1917 Carl Beck, who has seen many cases of hypospadias, had observed only one case of the complete form and this patient disappeared without operation.

In this severe form the scrotum is bifid. The testicles may or may not have descended and are often small. The penis is poorly developed, usually bent vertically, imperforate, and of no physiological use in its malformed condition. It is often mistaken for an enlarged clitoris which is concealed by the scrotal tissues and may resemble the labia majora. The urethral opening is nothing more than an orifice or a gutter in the perineum, lined with mucous membrane.

Mareto and Carpentier have discussed at length the etiology, pathology, symptomatology, and treatment of the perineal form of hypospadias. Parkham in the January, 1901, number of *New Orleans Medical and Surgical Journal* summarized the literature to date, which, as a whole, does not encourage operation for the deformity. He has also described and illustrated the various operations. He has the following to say concerning complete hypospadias. In the fourth form the deformity reaches its extreme degree, the scrotum being divided into two halves, looking so like a labia majora as to deceive one without careful examination. "Tillaux, in his lectures (*Leçons de Clinique Chirurgicale*, 1895, p. 367), tells how he came near making a serious mistake of this kind. The urethra opens at the bottom of this fissure. It might well be denominated false hypospadias.

"In this variety coitus is impossible; indeed, the more pronounced the erection the more the organ is bent forward. Fecundation, of course, therefore, is out of the realm of possibility. Micturition is retromingent and necessitates a squatting position to void soiling the clothing. Such a sufferer can, indeed, bless the hand that reconstitutes him a man."

The operations that are applicable to perineal hypospadias are all based on one of the following principles:

1. Formation of a new urethra by the use of flaps as advocated by DuPlay, Szymanowski, Russell, Angier, and others.

[1] Read before American Association of Genito-Urinary Surgeons

SUMMARY OF CASES OPERATED UPON FOR HYPOSPADIAS PERINEALIS FOUND IN AVAILABLE LITERATURE

Author	Patient's Age	Method	Drainage	Result
Brown and Ishmael		Tunnelization and insertion of catheter, constantly worn, until mucous lining formed. Later worn for several hours daily to prevent contraction. Closure of perineal fistula	Not stated	Good. Wife became pregnant
DuPlay		Straightening of penis. Formation of urethra with lateral flaps, sutured over catheter, 6 months later. Closure of fistula	Perineal	Good
Lewis		Scrotal flaps	Not stated	Fair. Bending
Lutaud		DuPlay's method (three stages)	Perineal	Good
Luecke	20	DuPlay's method	Perineal	Excellent
Waltz	9	DuPlay's method	Perineal	Good. Several operations had to be performed to close persistent fistula.
Karewski		Formation of urethra with lateral flaps	Perineal	Fair. Penis buried in scrotum.
Pegde	13	Straightening of penis. Formation of urethra with lateral flaps. Closure of perineal meatus	Not stated	Good
Pousson		DuPlay's method	Perineal	Good
Walther	13	Formation of urethra from grafts from thigh, and tunnelization. Nové Josserand method	Not stated	Good
Pousson	28	Formation of urethra with penile and preputial flaps	Not stated	Good
Montegnacco	7	DuPlay's method	Perineal	Good
Russell	9	Russell's method "Clergyman's stole" flap	Suprapubic	Good. Small fistula in middle third of [illegible] which could be closed by traction on penis and thereby prevent leakage.
Mayo, C. H.	6	Tunnelization. Formation of urethra with flap from prepuce and skin of dorsum of penis on pedicle. Joining of urethræ. Closure of fistula if necessary	Perineal	Good
Martin	12	Straightening of penis and perineal longitudinal division of corpora cavernosa. Covering raw area with Thiersch graft. After graft took, edges of graft were freed and sutured over catheter, forming urethra. Lateral flaps covered over newly formed urethra		Not stated
Curtis	10	Straightening of penis (1897). Formation of urethra with flaps. (Szymanowski method)	Perineal	Good. [illegible] finally closed.
Woolsey	5	Formation of urethra with flaps. (Szymanowski method)	Not stated	Good
Nové-Josserand	15	Tunnelization. Formation of urethra with graft thigh	Perineal	Good. Temporary fistula
Nové-Josserand	6	Above method	Perineal	Fair. No erections
Marion		DuPlay's method	Suprapubic	Good
Nové-Josserand	15	Tunnelization. Formation of urethra with flaps from perineum	Perineal	Good
Russell	8	Russell's method	Suprapubic	Fair. Two fistulæ [illegible] urethra
[illegible]		Russell's method	Suprapubic	Opening in middle [illegible] thra after two unsuccessful [illegible] at closure. Failure [illegible]
[illegible]		DuPlay's method	Perineal	Good

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Condition present before operation.
Fig. 2. View of patient following dissecting of penis before plastic operation on the urethra.
Fig. 3. View of patient following dissecting of penis before the plastic operation on the urethra.

2. Formation of a new urethra by tunnelling and the use of skin grafts according to the method of Nové-Josserand.

3. Formation of a new urethra by transplanting flaps on a pedicle from the prepuce and skin of the dorsum of the penis according to the method of Mayo.

The operation of DuPlay and Nové-Josserand are well described and illustrated in Cabot's *Modern Urology*.

Two procedures are essential to all methods, namely, straightening of the penis and preliminary drainage through the perineal fistula or suprapubic cystostomy, before the formation of the new urethra. A period of several months should intervene between the time of straightening the penis and the plastic reconstruction of the urethra to allow for any subsequent cicatrization.

The age of the patient is an important factor. Some surgeons advocate early operation, but the consensus of opinion favors surgical intervention between the sixth and ninth years when the operator can gain the co-operation of the patient.

In reviewing available literature at the Surgeon General's Library twenty-five cases of complete hypospadias have been found which have been subjected to operation. As a whole the recorded results have been good. Undesirable results have been:

1. Postoperative fistulæ along the course of the newly formed urethra in six cases, the majority of which finally closed;

2. Incurvation of the penis on erection in one case;

3. Failure of erection in one case;

4. Bending forward of the penis on erection in one case.

The almost uniformly satisfactory results obtained in the cases reviewed are probably misleading when all the cases of perineal hypospadias are considered, as undoubtedly more unsuccessful operative attempts have been made that have not been reported than successful operations that have been reported.

This patient was first brought to me in 1908 when he was 2 years old. Family history negative for any deformity in either paternal or maternal ancestors. When the child was born it was first thought to be a girl by the attending physician, but later it was discovered that some abnormality of the sexual organs was present.

At the time of my examination he was a well-nourished, wholesome-looking baby. On inspection of the genital organs there was every appearance of a female child with a large clitoris, the urethral opening having the appearance of a small vagina, neither testicle was down nor could they be palpated in the inguinal canal. The folds on each side gave

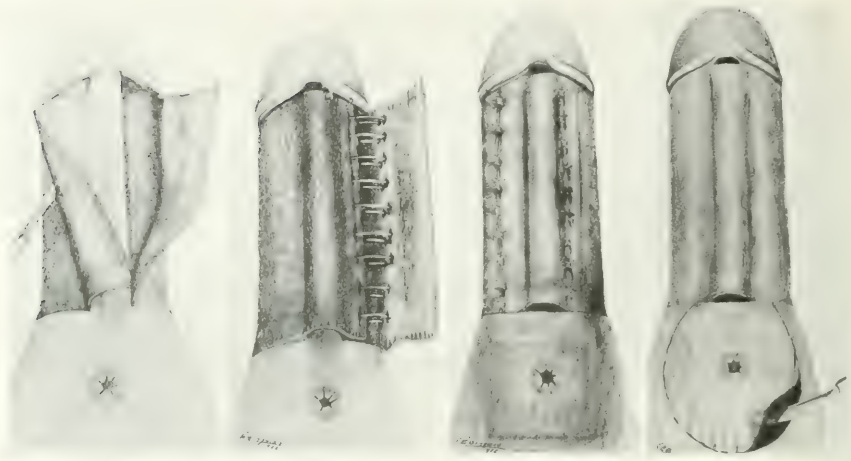


Fig. 4 Fig. 5 Fig. 6 Fig. 7

Fig. 4. Cutting flaps for formation of pendulous urethra.
Fig. 5. Flap in place. Silver wire passing through outside flap so as to facilitate removal.
Fig. 6. Completion of pendulous urethra.
Fig. 7. Incision to form bulbous urethra.

the typical appearance of a vulva, as shown in the drawing.

On close inspection of the clitoris-like glans, it was noted that the whole penis was covered with tissue except the glans, it, being firmly bound down and immobile. There was no attempt at a formation of a bulbous urethra, the opening in the perineum leading to the bladder which was easily catheterized as it was the beginning of the membranous urethra.

I saw this child at regular intervals until he was 9 years old. At this time I dissected the glans and corpora cavernosa from its surrounding tissues which so firmly bound it down as to make it immobile. A plastic operation was done to cover the top of the penis with skin and the bed from which it had been removed. This healed readily. There was no infection from the urine which escaped from the urethra located well down in the perineum. As soon as the wound had healed I had the mother every day take hold of the organ and make traction upward and forward to give it length and to overcome any tendency of curvature. As the penis was very miserable looking at this time I cannot help but feel that the traction had a great bearing on the ultimate result in this case, and it is a feature that has not been brought out in the cases previously reported. Treatment was continued until 1917. At this time the penis had grown considerably, both in length and size. His left testicle had been down for over a year. It was normal and well formed. Examination failed to elicit any evidence of the presence of a testicle on the right side. As the boy was now 11 years old and was perfectly willing to help in every way, it was decided to begin the building of a urethra.

There was no mucous membrane to work with as there was no vestige of mucous membrane on the under surface of the penis as is seen in cases of penile hypospadias; the under surface of the organ was perfectly flat with no sulcus at any point.

The accompanying photographs taken at this time show the condition presented at the time of operation, but the penis, while it appears in the pictures to have incurvation (on account of the continued stretching referred to before) was more apparent than real.

In collecting literature of cases operated on for complete hypospadias, we find that hardly any two have been operated upon in exactly the same way. This is probably due to the different conditions existing in different cases. The one that appealed to Dr. Fuller and to me was an operation borrowed from the surgeons who operate on cleft palate, the idea being to form a large urethra that would not contract and would not have to be dilated to prevent its closure. (Our patient at the present time has a made urethra that

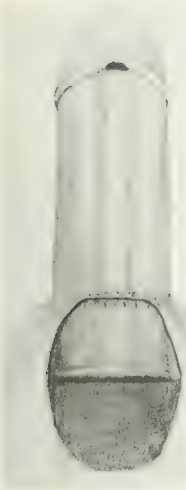


Fig. 8.

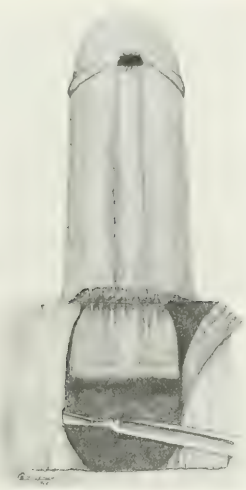


Fig. 9.

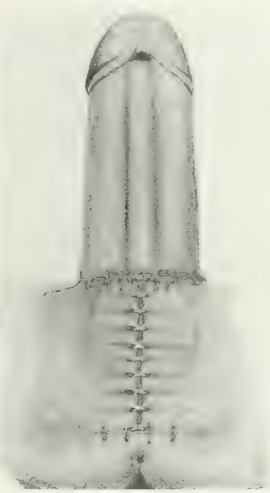


Fig. 10.

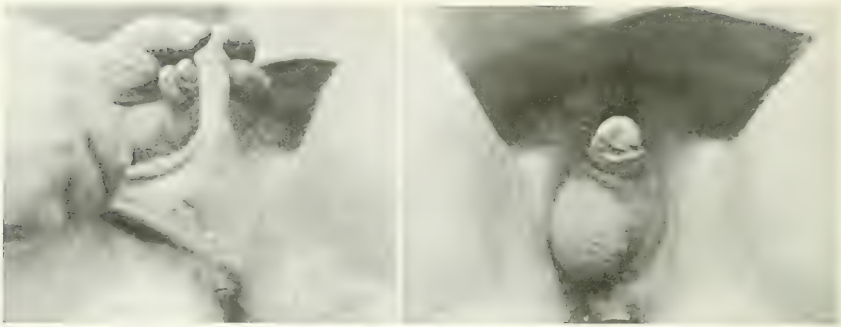
Fig. 8. First step in suturing flap to form bulbous urethra.

Fig. 9. Cutting of lateral flap to form bulbous urethra.
Fig. 10. Completion of suture to form bulbous urethra.

will admit over a No. 30 sound to the bulbomembranous juncture.) Furthermore, we were anxious to have no pulling or shortening of the urethra to cause a tendency to incurvation.

The first operation was performed in February, 1917, and consisted in an attempt to make a floor for the urethra from just behind the glans to 2 centimeters of the urethral opening in the perineum. This opening of the urethra was the entrance to the membranous urethra as indicated before.

An incision was made well over on the left side of the penis and carried back the whole side of the organ and the perineum down to within 2 centimeters of the urethral opening. The flap was dissected toward the median line to a point almost to the apex of the urethra. At each end of the longitudinal incision, necessary right angle incisions were made to permit the flap to fold over. The width of this flap was over 2 centimeters. Another longitudinal incision of equal length was made just to the right of the median line of the under surface of the penis, the flaps containing the skin and subcutaneous tissue. This flap was freed from the median line to the right, a distance to correspond with that on the left, right angle incisions being made at each end to correspond to the width of the flap. The left hand flap was folded over a silver tube that extended from the glans posterior to 2 centimeters from the perineal opening of the membranous urethra, and sutured with fine silver wire to the body of the penis, the silver wire passing through the skin of the left hand flap at its fixed border. After these sutures were placed they were twisted over small strips of gauze to prevent cutting the skin by the wire. This procedure made the inside of the urethra of skin. The freed right hand flap was brought over the raw surface of the left hand flap which formed the urethra, and sutured with silver wire at the margin where the left hand flap had been cut. This procedure made a skin covering so no granulation tissue was exposed. The ends of the new urethra were then sutured by interrupted fine silver wire and this was covered by silver foil and a small de Pezzer



Figs. 11 and 12. Ultimate result after operation.

catheter introduced through the urethra for drainage. This healed perfectly except at one or two points where sutures pulled out, the edges having to be freshened and resutured later. At completion of healing the perineal drainage was removed.

The result of this operation was that the patient had a patulous urethra of skin extending from the glans to 2 centimeters anterior to the perineal opening.

On June 4, 1917, 4 months later, an attempt was made to make a bulbous urethra and attach it to the penile urethra. A suprapubic cystostomy was done for drainage.

An elliptical incision, beginning at the sides of the new made urethra, was carried posteriorly around the opening of the posterior urethra almost to the anus and finished at the opening of the urethra on the opposite side. This was freed so that the posterior portion of the flap could be brought over to meet the new formed urethra. Lateral incisions were then made, freeing the skin over the perineum so it could be drawn to cover the raw surface of the flap that formed the bulbous urethra. Silver wire sutures were used in the same manner as in the repair of the penile urethra coming through the skin covering so they could be removed.

The edges of the posterior end of the newly made penile urethra were freshened, the surface denuded of skin, so as to insure healing of the flaps forming the bulbous urethra, at the points of juncture—silver wire sutures were used and were so placed that all could be removed. This was covered with silver foil and dressings applied. There was never any breaking down at this point. The suprapubic tube was removed in 2 weeks, and a week later the patient was voiding through the new urethra.

At this time I started to make an anastomosis between the anterior end of the urethra and the glans, an opening being made in the glans and a flap of skin being brought through and sutured, with the idea of later making this anastomosis, but as the boy had a useful penis both for urinating and copulating with no incurvation on erection, we felt it best to let well enough alone as we feared this might lead to incurvation and would necessitate frequent dilatation to keep the opening in the glans from closing.

His present condition is as follows: He voids a good full stream perfectly, the only abnormality being that he has to shake the organ to prevent any dropping of urine on his clothes. This is probably caused by our inability to produce the normal elasticity of the pendulous urethra. A No. 30 sound can be readily passed to the bulbomembranous juncture and a No. 20 sound into the bladder. His erections are normal without incurvation.

The results in this case are due to the following conditions:

1. The patient was seen early;
2. The penis was freed and stretched;

3. Too much was not attempted at one time, but the parts were allowed to become adjusted between operations;

4. Large flaps were used thus avoiding tension and the placing of the sutures so no two rows were in the same plane;

5. Drainage through the made urethra was not attempted;

6. The repair operation on the urethra was postponed until the child was old enough to understand the importance of following directions.

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THE COMPLICATION OF PURPURA WITH GESTATION[1]

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PURPURA hæmorrhagica is a rare complication of pregnancy. In the literature are 39 cases which have been reported. There is, of course, no method of estimating the number which may have been actually encountered and not recorded. Apparently multiparæ are the more frequently affected, as published observations show that 28 cases were found among women between the second and fifth pregnancies, against five primiparæ and 6 cases after the fifth gestation.

As to age incidence, purpura occurred twenty-two times between the ages of 22 and 35, six times under 22 and eleven times above 35 years.

Purpura seldom appears throughout the gestation; however, there is a marked predominance between the sixth and seventh months. One notes that in 22 cases it appeared before the eighth month, in 12 before the sixth month, and in 5 cases after the eighth month.

It is surprising how little the general condition of the patient in some cases is modified by purpura hæmorrhagica. Often in the most alarming there may be no systematic disturbance whatever, although marked anæmia and a state of asthenia may develop as a result of the continued loss of blood. With this may occur gastro-intestinal upset, thready pulse, and fever. There is often œdema and a trace of albumin in the urine.

Stephen Mackenzie has divided purpura into autotoxic, vascular, mechanical, and neurotic. Doubtless in pregnancy we have a combination of the vascular and toxic groups with a neurotic influence. The case of hæmorrhagic diathesis reported subsequently in this paper belongs, it is believed, to the group described first by Denys and Hayem, and since then has been studied carefully by Bensaude and Rivet, Pratt, Duke, and others.

Duke reported a series in 1910, in which he attempted to prove that both hæmorrhage and purpura in one type of case could be attributed entirely to an almost complete absence of blood platelets, and in doing this found, after study of normal individuals and patients with numerous diseases, that this type of hæmorrhagic diathesis had invariably a reduced platelet count whenever they had a tendency to bleed. The tendency to bleed was studied by means of the bleeding time—not the coagulation time. This was prolonged in both human subjects and in experimental animals whenever the platelet count was reduced to a certain level (10,000), and this was associated in humans with bleeding from mucous membranes and ecchymoses. In one case, in which the count was reduced below 3000, the patient bled from scratches, pin pricks, minute injuries made on the gums by the chewing of rough food, from acne pustules, hang nails; in fact from any abrasion whatever, either of the skin or tissue. He also found that the condition could be relieved immediately by direct transfusion of blood, which operation caused instant increase in the platelet count. The platelets were found to be short lived, under these circumstances, and disappeared in from 3 to 5 days, at which time the hæmorrhagic diathesis, in all its glory, returned. Hæmorrhagic diathesis was relieved, in some of his cases, by a spontaneous increase in the platelet count. He felt, from a study of a series of cases in 1912, that one group of hæmorrhagic cases could be separated from a variety of other types by a clinical picture which was characterized in every instance, first, by a tendency to bleed into the skin and tissues, and from every abrasion, no matter how made; second, by an enormously reduced platelet count—from one thousand to fifty thousand; third, by a normal coagulation time; fourth, by a prolonged bleeding time —10 minutes to 1½ hours (the normal bleeding time is less than 3 minutes), and, fifth, by a non-retractile blood clot. These cases were analogous, he thought, to those described by Denys, Hayem, Pratt, and others.

This disease was found to be of varying etiology. It was noted complicating diphtheria,

tuberculosis, nephritis, aplastic anæmia. Similar illnesses were reported in the literature complicating lymphocytic leucæmia, hæmorrhagic small pox, typhoid fever, and pneumonia. The case which is to be reported subsequently was similar to these, it is believed, and occurred as a complication of pregnancy.

In a series of thirty-eight animal experiments in which benzol, diphtheria toxin, and tuberculin were injected into animals, in only those in which the platelet count was markedly reduced was there any abnormal tendency to bleed. In one animal treated with diphtheria toxin, typical purpura hæmorrhagica with a very low platelet count, non-retractile clot, and prolonged bleeding time was produced.

The normal platelet count, as given by different observers, ranges between 200,000 and 400,000. Hayem in his cases of purpura hæmorrhagica made counts of 89,000, 62,000 and 41,000. Bensaude and Rivet studied fresh blood films in 5 cases of purpura hæmorrhagica and noted that the platelets were greatly reduced. In studying purpura hæmorrhagica complicating nephritis, Pratt noted a count of 9,000. Selling, in a case of benzol poisoning with purpura hæmorrhagica, noted a platelet of 3,000.

Hayem, Denys, Bensaude and Rivet, Duke, Minot, and others, all agree in their observation of a striking tendency to bleed in patients with very low platelet counts, and in several instances note an amelioration of symptoms with a rise in the count. Duke, with his patients and animals, noted hæmorrhagic diathesis in mild form whenever the count was below 60,000, and in severe grade when the count was below 10,000.

It is interesting to mention in this connection the origin of blood platelets, since it seems likely that a certain type of purpura hæmorrhagica is due either to a reduced formation, or to an increased rate of destruction of platelets. The most interesting work in this relationship is that of J. H. Wright, who states, on the basis of microscopic examination of the bone marrow, that the source of the blood platelet is the megacariocyte of the marrow, and that platelets are formed by the budding off of pseudopods which are projected into the capillaries from the megacariocytes. His observations have been corroborated by other observers.

The characteristic symptoms of purpura of the platelet-free type are:

1. Petechia and ecchymosis. The rash may be modified by any co-existing skin lesions, or by mechanical agents, such as that produced by a bruise or by rubbing.

2. Bleeding from mucous membranes. This accompanies the petechia almost always, and ecchymosis usually.

3. Prolonged bleeding time. This was observed in all cases where there was a tendency to bleed with a return to normal immediately if the platelet count rises. This feature is found constant and distinctive, and it is the most reliable guide we have in showing the severity of hæmorrhagic diathesis in this type of trouble.

4. A reduced platelet count. This ranges from 60,000 to nearly nil. Usually the count is so reduced that the platelets can hardly be found in either counting chambers or blood smear. A rise above 10,000 is almost invariably associated with a reduction in the bleeding time, and an improvement in the patient.

5. Normal coagulation time.

6. Non-retractile clot. Retractility of the clot seems to depend on the presence of blood platelets, and returns when the counts rise to a certain limit (40,000).

The fundamental cause of many types of purpura is still unknown. Some evidently occur in connection with infections and with intoxications, and this would seem to point to a relationship of cause and effect. While it is not capable of demonstrable proof this suggestion must be given consideration.

It has been argued that purpura in pregnancy is no different from that in the non-gravid woman. A few observations of Henri Vignes on the changes in the blood of the normal pregnant woman are pertinent and interesting. In normal gestation he finds,

1. The blood mass is augmented by 8 per cent, through superabundance of serum.

2. The number of red blood cells is clearly diminished, as is also the hæmoglobin ratio.

3. The cells have the property of sedimenting with greater rapidity in pregnancy. Following the technique of Lingemeier, it takes 5 to 6 hours to precipitate *in vitro*, completely, the blood cells of a woman not pregnant nor in her menstruation. It requires less than 2 hours to produce the same phenomenon in a woman 7 or 8 months pregnant.

4. There exists as light leucocytosis, more marked in primiparæ. Baer gives the figures as 11,000 for primiparæ, and 6,000 for multiparæ. These figures are increased by 50 per cent during labor, and especially if there be an early rupture of the membranes. The increase is more particularly in the polymorphonuclears.

Consequently, when we consider that the barriers protecting the woman non-pregnant are broken down by the blood change occurring in the sixth or seventh months of pregnancy, there should be reason for her greater danger from purpura.

Ferroni believes in the classic theory which attributes the hæmorrhagic troubles of purpura to a lesion either of the kidney or the liver, under the influence of the nervous system, this applying more distinctly to purpura gravidarum.

The new ideas of E. Frank and Kaznelson, who speculate on the preponderant rôle played by the spleen in the pathology of purpura, are interesting, but they are not as yet confirmed by a long experience.

John Phillips, in an elaborate discussion of purpura in menstruation and pregnancy, says that women with amenorrhœa or irregular menstruation have a disposition to erysipelas of the face, erythema nodosum, purpura simplex, and purpura hæmorrhagica, which he thinks are only degrees of the same hæmorrhagic disorder. He reports 3 cases of purpura in non-pregnant females occurring at the menstrual time, one of whom died of hæmorrhage.

Peusch reports a woman of 21, who, a year after the birth of a child, had a severe headache and petechiæ. In 10 days a normal menstruation of 3 days' duration occurred. Her next period was at the proper time, but excessive. On the fourth day she fainted. Hæmorrhage from the bowel was profuse and a uterine hæmorrhage followed, which continued for 10 days. After several weeks the rash disappeared and she made a slow recovery.

From the foregoing description two facts are apparent:

1. Purpura may be related to a known disease of which it is a symptom, or it may be a complication showing the violence of the pathogenic germ.

2. It may be only the expression of a state of which the cause is unknown, residing probably in the functional modification brought by the pregnancy into the maternal organism. This last series of cases is denominated idiopathic purpura.

Among the affections which determine purpura in pregnancy is scurvy, which Zangemeister remarked in his case. He argued that the scurvy shows symptoms so slightly at variance with the gastro-intestinal conditions, progressive anæmia, muscular and articular pains, and cutaneous hæmorrhages, which one meets in gestation, that differentiation is difficult and the same form of disturbance is likely responsible.

The evolution of symptoms is similar to those in the cases reported by Bregier and Ferroni, where the general picture resembled scorbutic purpura, but the affection taking a serious turn may go on in one instance to a fatal termination, while in another the patient recovers her equilibrium with no untoward result.

Well-defined hæmophilia is always easily recognized, but there are in addition instances like that which Grazzani reports of women not hæmophiles who, nevertheless, bleed excessively when they are pregnant and in labor and also postpartum. This circumstance is also noted by Phillips and Rowe, as if pregnancy had reinforced the tendency of the scorbutic cachexia responsible for much disorder in the maternal organism, interfering with its repair, even after the expulsion of the products of conception.

Diehl, in a classification of purpura, includes scorbutic purpura and maintains that the petechiæ are in this case secondary to the scorbutic cachexia. Purpura due to tuberculosis, malaria, and cardiopathies are analogous. He says to differentiate scurvy in pregnancy is

difficult, as the gestation itself is often accompanied by alimentary disturbances reflex in origin.

From a clinical point of view the facts present themselves in the great majority of cases as follows:

The victim is usually a multipara. Her age is from 22 to 35 years. The patient shows at first the appearance of good health, and the family history may be negative. Her former pregnancies have been normal and each one terminated with the birth of a full term, living infant. Her present pregnancy may have been normal or there may have been a complication of metrorrhagia of sufficient importance to attract attention, when the woman finds herself again enciente. The beginning of the pregnancy is not marked by any serious accident. At this time she may have noted a peculiar odor which seems to come from a fermentation of gastro-intestinal origin. To all appearances, however, she is in good health and her gestation shows no untoward symptoms until sometime in the sixth or seventh month she experiences a vague discomfort, loses appetite, and complains of headache; she has palpitation and a gastro-intestinal trouble which becomes more marked. Some time later there appear hæmorrhagic spots on the skin, then petechiæ, which are at first discrete, but later become confluent. These spots usually appear in successive crops. The woman finds that her gums are tumefied and painful and begin to bleed; epistaxis becomes troublesome; she usually has a persistent diarrhœa; she consults a doctor, who finds that the fetus is living, but that the mother has purpura with symptoms of grave character. The patient is usually pale and depressed, short of breath, although no abnormal symptoms can be found in the heart, lungs, or other organs. Blood pressure may be normal, the pulse is rapid, corresponding with that of a light fever. A trace of albumin is usually found. She may improve. The reverse is generally the case. Gastro-intestinal troubles increase. Mucous hæmorrhages are frequent. The patient bleeds from the mouth, the nose, the bladder, and the rectum. She becomes rapidly anæmic and exhausted, is confined to her bed. Hæmorrhages increase from all mucous surfaces, the temperature rises. She goes into rapid labor without great pain. She is delivered normally and may begin to improve. Generally, however, she dies after a few hours or a few days because, for some reason, the organism cannot re-establish itself after expulsion of the products of conception.

PROGNOSIS

The prognosis in cases where purpura hæmorrhagica complicates pregnancy becomes very grave. The outcome is generally less serious when an early abortion ensues. Only occasionally a patient goes to term and recovers. Involution is more or less prolonged.

In half of the cases the fetus perishes *in utero*, or dies within a few days following the birth. It presents, usually, however, a normal appearance. Very rarely there develop hæmorrhagic accidents to the fetus, analogous to those of the mother.

A brief list of case reports instructs one on the prognosis.

Phillips, two cases, British Lying-in, 1887. One, age 32, para-VII, recovered, the other died of hæmorrhage the second day following delivery.

Peuch, primipara, sixth month, epistaxis, petechiæ, no external hæmorrhage, died the fifth day.

Peuch, para-V, age 30, eighth month, petechiæ suddenly overspread the entire body, fetus expelled the same night, postpartum hæmorrhage, death.

Budd Van Sweringen, Ft. Wayne, 1905, primipara, sixth month, whose cervix had been thrice cauterized by preceding attendant for pernicious vomiting,—found nose bleeding and gums oozing, bloody urine, profuse vaginal discharge, profound dyspnœa, petechiæ general over body, slight temperature. Symptoms cleared up in a few days. Delivered 3 months later with no purpuric symptoms.

Robert Barnes, Brit. M. J., para-III, sixth month, rheumatic pains, fever, premature fetus lived 3 hours, purpuric spots appeared same day. Prostration, delirium and hæmorrhage were followed by death in a few hours.

Barnes and Byrnes, Brit. M. J., Nov., 1867, patient developed spots of purpura hæmorrhagica, subconjunctival ecchymoses, prostration and delirium, died day after delivery. Two days later her husband developed variola.

Wiener, Arch. Gynaek., 1887, xxi, 281, hæmorrhagic purpura in two sisters: the first dies suddenly after rash appears, the second is taken 14 days later in seventh month with identical symptoms, is delivered next day. During delivery a scarlatiform rash appears on head, neck, and trunk, hæmorrhages of skin present themselves, bloody expectoration, hæm-

aturia, sanguinolent stools. Woman dies third day with no elevation of temperature. At the time an epidemic of small pox prevailed in Breslau.

Ferroni, Rome, 1903, para-IV, age 31, sixth month, discrete petechial rash localized on thorax and lower limbs. After 12 days bloody stools, albuminuria, profound anæmia. Suddenly delivered voluntarily of living baby showing no traces of purpura. Two hours later after declaring she felt better, she suffered profound dyspnœa which was followed by loss of consciousness and death.

Diehl, Ztschr. f. Geburtsh., 1899, p. 218, reports a para-VII, age 36, no history of bleeders, six confinements normal. Patient expelled dead fetus at eighth month, no notable bleeding. Later she developed general purpuric hæmorrhages, uterus at umbilicus became gangrenous and there was a vaginal discharge. Blood examination was negative. Six days later patient suffered violent pain, and petechiæ and ecchymoses succeed in crops; she had no fever, but died on eighth day.

Hanot and Luzet, Arch. Exp. Med. & Path. Anat., 1891, xv, 772. Primipara, age 22, at term suddenly suffered occular disturbance and coma; petechiæ and ecchymoses appeared, a macerated fetus was expelled. The next day patient went into deep coma, albumin was notable, and woman died. Autopsy showed cerebric spinal meningitis.

Le Clerc, Lyon médical, 1908, reports a hæmophilic, age 32, para-V, with three living children, one a hæmophilic. Purpura at third month with epistaxis, bleeding of gums, and conjunctival effusions. Fourteen days later she was delivered with slight loss of blood of a dead child. Blood examination showed polymorphonuclears 86 per cent, mononuclears 13 per cent, non-retractile clot, normal coagulation time. Patient died next day.

TREATMENT

As to the treatment of purpura hæmorrhagica little is to be said. The use of drugs, either styptics, general remedies, or serums, has been found futile. Complete rest should be advised, and patient should eat nourishing food, and perhaps be given a tonic.

Transfusion is the only effective means of controlling the hæmorrhage, and may have a prolonged or even permanent effect. The theory suggested by Duke that the increased blood platelet count—above 10,000—results in control of the hæmorrhage, seems a plausible one to account for the favorable result.

Repeated transfusion may be required to tide over a temporary process which caused a platelet deficiency, and this may lead to a cure. At present no other method of treatment has been found worthy of trial.

AUTHOR'S CASE

The especial reason for the presentation of this subject at this time is that, during the summer of 1922, the author saw in consultation with a very careful diagnostician and able practitioner, his friend, Dr. John I. Byrne, of St. Joseph, Missouri, a case of purpura hæmorrhagica complicating pregnancy, in a patient whose history is appended.

Mrs. A. F. S., age 36, para-VI. She has always been under the care of Dr. Byrne in each of her labors. Her first confinement was perfectly normal. The second child was born without untoward symptoms, but in the third month following the birth the mother developed an acute appendicitis. The appendix was perforated within 12 hours after the onset of pain. Operation was followed by a somewhat stormy convalescence and complete recovery.

The third pregnancy began soon after the recovery from the appendicitis. She became toxic and several convulsions were suffered, but the child was delivered near term and lived. Her fourth and fifth pregnancies were normal in every respect.

The present trouble developed in the sixth month of the last pregnancy with painful purpuric spots on the legs and abdomen, and these gradually affected the whole body. At the end of 3 weeks, hæmorrhage from the gums and nose began. At that time 10 cubic centimeters of normal horse serum was given and this completely controlled the symptoms for 3 weeks. Then followed repeated hæmorrhages from the bowels, nose, and gums. She was desensitized and the horse serum was repeated, but it failed to stop the bleeding. A transfusion of 350 cubic centimeters of citrated blood was given. This partially controlled the hæmorrhage but oozing was still observed. Various styptics, such as calcium lactate and stypticin, were given, but without effect.

Because of fear of more extensive bleeding consultation was called and it was decided, as the patient was becoming more anæmic and consequently weaker, that an induction of labor should be done before the control of the transfusion was exhausted.

Accordingly, in anticipation, another transfusion was done and the Voorhees bag was used to inaugurate labor pains. After 6 hours, a baby girl, weighing 6½ pounds, was delivered and lived 10 hours. The child seemed strong and well developed, but it was noticed in a short time that wherever it had been touched by the hands large ecchymotic spots appeared. The ecchymoses gradually increased although there was no hæmorrhage from mucous membranes. This feature is of especial interest from the viewpoint of heredity, since, in nearly all of the other cases found where purpura developed, there was no evidence of the condition being transmitted to the offspring. The authors quoted, where mention is made of the subject, usually observe that the purpura was not transmitted. This child was

evidently a bleeder, and the source of its disturbance was like that of the mother, probably a toxæmia. In this particular, the case is, so far as we have been able to determine, unique in that both mother and child suffered from an identical condition.

There was no time during this last pregnancy any sign of kidney disturbance, and while the bleeding from other mucous membranes was quite free, no blood was found in the urine. There was no excessive bleeding following the birth, and all other hæmorrhages promptly ceased as soon as the patient was delivered. She was discharged from the hospital at the end of 2 weeks after the birth and is now, apparently, in better health than usual.

CONCLUSIONS

1. Purpura is a very rare complication of pregnancy. The literature includes 39 cases previous to this report.

2. Purpura in gestation is most often of the hæmorrhagic form, characterized by these symptoms: hæmorrhages from mucous surfaces; petechiæ and ecchymoses; a remarkably reduced platelet count; prolonged bleeding time; normal coagulation time and non-retractile clot as in the non-gravid woman similarly affected. With the gravid woman, however, there is greater frequency of metrorrhagia.

3. Beside the purpura hæmorrhagica associated with a definite pathological state complicating gestation, there are others more rare, which may be denominated idiopathic purpura of gestation.

4. Idiopathic purpura always manifests a harmful influence in gestation, usually resulting in premature delivery.

5. Multipara between the ages of 22 and 35 are most often affected. Usually the patient is in the sixth or seventh month of her pregnancy.

6. Purpura is frequently complicated by infection, but some cases occur without any real evidence of infection. Toxæmias appear responsible for a number of cases.

7. The offspring of purpuric mothers are not usually affected by the eruption, although in the present case, the child developed ecchymoses.

8. The fetal mortality is 50 per cent.

9. Nearly all cases of purpura hæmorrhagica which go to term end fatally at the delivery, or soon after the labor, from hæmorrhage.

10. No drug therapy is of the slightest avail. Direct transfusion of blood, keeping the platelet count over 10,000, is the only remedy. Repeated transfusion may be necessary to tide the patient over the period in which her platelet count is reduced.

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A FURTHER DISCUSSION OF GERMICIDES AND PRESENTATION OF A NEW GERMICIDE—MEROXYL

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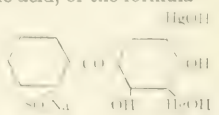
TWO of the present writers in conjunction with Dr. E. O. Swartz, presented in 1919[1] and again in 1921,[2] papers on a new mercurial germicide, mercurochrome. In these papers we set forth the reasons for an attempt to make improvements in the antiseptic treatment of wounds and mucous surfaces, and gave in considerable detail the bacteriological, animal, and other laboratory experiments, and the clinical results which we had obtained with the powerful mercurial germicide to which we gave the name of mercurochrome. Since these papers were written a considerable number of clinical papers has appeared, and the position of mercurochrome as a valuable germicide has been established.

Work on the drug which is the subject of this paper had its inception in an attempt to produce a substitute for mercurochrome which would retain the therapeutic properties of that drug but be without the stain. In other words, search was made for a mercurial which should at once have high germicidal value, sufficiently low toxicity to permit its use in body cavities, as little irritation as possible for delicate tissues and *penetrating power without staining*, or what might be called "invisible staining." The properties possessed by the drug which we have called "meroxyl"[3] do not correspond exactly with the desiderata just mentioned as an ideal, in that some of the desirable features have been intensified at the expense of others. The new drug was found to be far more powerful as a germicide, *in vitro*, than mercurochrome and to be entirely free of staining quality. On the other hand the toxicity was found to be higher than that of mercurochrome, the precipitating action on protein more noticeable (with consequently greater irritation to tissues) and *no evidence was found of the power of the drug to penetrate tissues*. From a laboratory standpoint, therefore, it appeared probable that the usefulness of the drug would lie particularly in those fields in which the more superficial, easily reached infections were to be dealt with.

Experience in various branches of medicine and surgery has shown that the new drug is to be regarded as a complement of mercurochrome but by no means a substitute for it. Where deep penetration and extreme blandness are of prime importance or where it is desired to secure a permanent deposit of a disinfective agent which will not be rapidly washed away by body fluids, the new drug, meroxyl, has certainly not been found superior to mercurochrome and is probably not as effective. On the other hand, for purposes such as surgical irrigation and dressing of wounds meroxyl seems to have a wide field of usefulness not possessed by mercurochrome. This general suggestion is made as to the indications for the use of meroxyl because our experience with mercurochrome, which was originally intended only as a urinary antiseptic, shows that when a new drug is made generally available experiments will be made with it in practically all therapeutic directions.

DESCRIPTION OF MEROXYL

Meroxyl is the sodium salt of 2-4-dihydroxymercuri-3, 5-dihydroxybenzo phenone-2′-sulphonic acid, of the formula



[1] Young, H. H., White, E. C., and Swartz, E. O. A new germicide for use in the genito-urinary tract: "mercurochrome-220." J. Am. M. [illegible]

[2] Young, H. H., White, E. C., and Swartz, E. O. Further clinical studies on the use of mercurochrome as a general germicide. J. Urol., [illegible]

[3] As will be apparent from the structural formula, the hydroxyl groups are important factors in determining the properties of the parent organic substance as regards mercuration. The derivation of the name "meroxyl" is then obvious. During nearly 2 years of clinical experimentation [illegible]

The product is formed by the mercuration of the parent organic substance, but the impossibility of complete mercuration, on mechanical grounds, and the difficulty of isolating the pure substance in any considerable quantity have led us to use a mixture which contains about 50 per cent of the pure compound, the remainder being made up of unmercurated parent substance, moisture, and inert inorganic salts. This mixture has served well clinically, so it does not seem necessary to work with the pure material. *In stating the strengths of solutions hereafter we give figures referring to the content of pure compound.*[1]

The mixture is a flesh colored to pink powder, stable indefinitely, easily soluble in distilled water. Solutions as strong as 5 to 10 per cent can be prepared with hot water but tend to gel or deposit the material on cooling and standing. Weaker solutions up to 2.5 per cent are permanent as far as fluidity is concerned but deteriorate in germicidal value. We have made it a practice never to use solutions older than a week.

The color of the solutions varies with concentration. A 0.5 per cent solution shows a peculiar pale, brownish-pink color with slight green fluorescence. This color tends toward brown in stronger solutions or thicker layers, and toward pink in more dilute solutions or thinner layers. In spite of the rather marked depth of color in solution, the drug produces no stain whatever on the skin or on fabrics.

The powder contains about 25 per cent of mercury, whereas the formula for the true substance given above requires a content of 53.5 per cent of the metal. The low mercury content of the powder is not due to the presence of any *mono*-mercury derivative, for the isolation of pure substance shows the formation of the dimercury derivative even when the ratio of mercurating agent to parent substance is 1:1 or less.

Solutions of meroxyl give no precipitate with sodium hydroxide or potassium iodide, showing that the mercury is in non-ionic form. The behavior with ammonium sulphide depends on the strength of the solution. A 2.5 per cent solution blackens almost instantaneously, a 1 per cent solution after a few seconds, and a 0.5 per cent solution remains clear for a time, but usually blackens within a minute, a cloud spreading through the solution suddenly, like a blush. This reaction was taken advantage of in attempts to demonstrate penetrative power of the drug in tissues. Solutions of meroxyl as strong as 0.5 per cent form a slight cloud with serum, but weaker solutions (1:1000 or less) do not show precipitating action on protein.

A characteristic reaction of this drug is that it behaves like a phenol and couples with diazo solutions to form dyes. The compound formed with diazotized p-nitraniline has a deep bordeaux-red color.

Attempts to demonstrate penetrating power of meroxyl. Since meroxyl does not stain tissues, experiments bearing on the question of its penetration require that the drug be "developed" into a precipitate or a brightly colored substance. For this purpose the reactions with ammonium sulphide, whereby a black insoluble precipitate of mercuric sulphide is formed, and with diazotized p-nitraniline, whereby a dye is formed, were utilized.

A solution of meroxyl was injected into the excised bladder and kidney of a rabbit, washed out after three minutes, frozen sections were cut in a direction perpendicular to the surface of application, the "developers" were applied and the sections were examined microscopically. The method of development of a dye was found unsuitable. Some of the meroxyl adhering to the mucosa, of course, developed into dye, but this was water-soluble and the dye solution distributed itself over the whole section, masking any penetration that might have taken place. The method of precipitation of mercuric sulphide proved feasible, as the substance developed consisted of dark, insoluble particles which did not run. Unfortunately, their presence was found to be confined to the surface of the mucosa, indicating that the meroxyl solution had not penetrated to any depth.

Toxicity. Toxicity was determined on dogs, by intravenous injections and by feeding through a stomach tube. The first method showed rather high toxicity. The tolerated

[1] In preparing solutions from the powder we have used twice as much powder as the true strength indicates. Thus, two grams of powder in 100 cubic centimeters of water makes a 1 per cent solution. It is, of course, possible to prepare tablets such that one tablet in a suitable volume will make a solution of a desired strength based on content of pure drug.

dose was 1 cubic centimeter of a 0.25 per cent solution per kilogram of body weight, or 2.5 milligrams of the pure substance per kilogram. This dose produced albumin and casts in the urine, but no decrease in phthalein output. After one month albumin was still present, there were no casts, and the phthalein output was normal. Two cubic centimeters of a 0.25 per cent solution per kilogram was fatal, a heavy albuminuria being produced within a day, with suppression of phthalein output to a trace, and death 2 days later. A dose of one-half the tolerated dose — 0.5 cubic centimeter of 0.25 per cent solution, or 1.25 milligram of pure substance per kilogram apparently had no effect whatever on the animal, urine findings being entirely negative 1 week after the injection, with normal phthalein output.

The toxicity after oral administration is low. The maximum amount of a 0.5 per cent solution of the powder that a dog will retain is 10 cubic centimeters per kilogram; larger amounts are lost by vomiting. Retention of the amount indicated led to a diarrhœa lasting 1 day and a very slight decrease in phthalein output, which, however, returned to normal within a week. As this dose is equivalent to a total of about 600 cubic centimeters in a man, it seemed quite safe to use small amounts of dilute solutions of the drug in body cavities, where it was unlikely that there would be even as high a degree of absorption as from the stomach and intestines. Early clinical experiments on the use of the drug in the genito-urinary tract were therefore made cautiously and with dilute solutions. We have used this drug extensively for about a year and a half, in which period we have observed only two cases in which there was any evidence at all of toxic absorption and in these cases it was slight and transient. These two cases will be referred to in the clinical part of the paper.

Bacteriological tests with meroxyl. The action of meroxyl *in vitro* has been studied in three media of exposure, 0.875 per cent sodium chloride solution, normal urine of PH 6.4, and 50 per cent dog serum. In this way, close approximation of the action of the drug under widely varying conditions has been obtained. The tests in 0.875 per cent sodium chloride solution furnish an estimate of the action of the drug in the absence of organic matter and are the most favorable, while the tests in 50 per cent serum are more rigid than in the average medium of action of the drug *in vivo*, and are the most unfavorable experimentally. The unavoidable variations in the chemical composition of different urines, used for tests, are paralleled by similar variations clinically.

The action of the drug was studied chiefly against bacillus coli, staphylococcus pyogenes-aureus and the gonococcus, with some tests against pseudomonas pyocyanea and bacillus pneumoniæ. Parallel tests were made with three strains of each organism, in order to lessen the source of error of possible variation of any one strain.

All organisms except the gonococcus were tested by the following method: 5 cubic centimeters of the sterile medium of exposure was inoculated with 1 loopful of a 24-hour broth culture of the test organism, the culture having been filtered through glass-wool to remove clumps of organisms. The number of organisms added was estimated by dilution and plating. To this organism-medium of exposure mixture was added 0.5 cubic centimeter of the drug, eleven times the strength of the final dilution desired $\left(\frac{5.0+0.5}{0.5}=11\right)$. The drug was always added after the organisms, to eliminate the possibility of any drug-medium combination without organisms. At

TABLE I.—BACTERICIDAL VALUES OF MEROXYL AGAINST BACILLUS COLI AND STAPHYLOCOCCUS PYOGENES-AUREUS IN 50 PER CENT DOG SERUM, PH 6.4 URINE AND 0.875 PER CENT SALT SOLUTION

Exposure Time	B. coli, strain 1 (average number of organisms per c.cm. before addition of drug.			S. aureus, strain 1 (average number of organisms per c.cm. before addition of		
	0.875 per cent NaCl.	P.H. 6.4	50 per cent dog serum	0.875 per cent NaCl.	P.H. 6.4 urine	50 per cent dog serum
1 minute	1:10,000			1:2,000	1:700	1:700
5 minutes	1:70,000	1:20,000		1:2,000	1:700	1:2,000
60 minutes						

TABLE II.—TABLE OF COMPARATIVE BACTERICIDAL VALUES OF MERCUROCHROME AND MEROXYL

	MERCUROCHROME				MEROXYL			
Exposure time	1 minute		1 hour		1 minute		1 hour	
Medium	50% serum	Norma NaCl.	50% serum	Normal NaCl.	50% serum	Normal NaCl.	50% serum	Normal NaCl.
B. coli 1	1:200	1:200	1:600	1:200,000	1:10,000	1:10,000	1:20,000	1:200,000
B. coli 117	1:100	1:100	1:500	1:100,000	1:6,000	1:8,000	1:20,000	1:600,000
B. coli 118	1:100	1:200	1:500	1:100,000	1:6,000	1:12,000	1:20,000	1:400,000
3-strain average	1:100	1:150	1:500	1:100,000	1:7,000	1:10,000	1:20,000	1:400,000
Staph. pyogenes-aureus 1	1:90	1:100	1:200	1:70,000	1:600	1:000	1:2,000	1:400,000
Staph. pyogenes-aureus 2	1:90	1:90	1:200	1:200,000	1:400	1:400	1:4,000	1:400,000
Staph. pyogenes-aureus 3	1:90	1:100	1:200	1:100,000	1:400	1:600	1:6,000	1:800,000
3-strain average	1:90	1:90	1:200	1:100,000	1:400	1:500	1:4,000	1:500,000
Ps. pyocyanea 279	1:100	1:100	1:300	1:100,000	1:600	1:1,000	1:10,000	1:1,000,000
Ps. pyocyanea 280	1:100	1:100	1:300	1:200,000	1:600	1:1,000	1:10,000	1:400,000
Ps. pyocyanea 282	fails 1:50	1:90	1:300	1:100,000	1:600	1:1,000	1:8,000	1:800,000
3-strain average	1:60	1:90	1:260	1:130,000	1:300	1:1,000	1:9,000	1:700,000
B. pneumoniæ 1	fails 1:50	1:90	1:450	1:70,000	1:4,000	1:1,000	1:10,000	1:2,000,000
B. pneumoniæ 98	fails 1:50	1:90	1:500	1:60,000	1:6,000	1:10,000	1:10,000	1:1,000,000
B. pneumoniæ 99	1:50	1:100	1:700	1:80,000	1:3,000	1:10,000	1:8,000	1:1,000,000
3-strain average	1:10	1:93	1:500	1:70,000	1:4,000	1:8,000	1:9,000	1:1,000,000

3-strain averages are put as the nearest round number below the arithmetical mean.
Strains failing to kill 1:50 are counted as 0 in estimating 3-strain averages.
B. coli 117, 118; Ps. pyocyanea 279, 280, 282; B. pneumoniæ 98 and 99 were obtained from the Hygienic Laboratory; B. pneumoniæ 1, from the Johns Hopkins Medical School; other organisms from the Brady Urological Institute.
Killing dilution given indicates failure to kill at next dilution.

the end of the desired exposure time, 0.1 cubic centimeter of the final mixture was removed and planted in beef-infusion broth, PH 7.6, proper dilution being made through test dilutions of 1:5000 to check possible inhibition in the broth, due to carrying over the drug, as determined by control tests. Tubes were then incubated for 48 hours at 37.5° C., the exposure having been made at room temperature. Drug dilutions were used as follows: to 1:100 by tens; from 1:100 to 1:1000 by hundreds; from 1:1000 to 1:10,000 by thousands; from 1:10,000 to 1:100,000 by ten thousands; from 1:100,000 to 1:1,000,000 by hundred thousands; 1,000,000 and more by millions. Three tests were made each time on each dilution, and the final reading which showed three sterile tubes after 48 hours' incubation, with growth in one or more of the tubes of the next weaker dilution, was taken as the killing dilution. Tests were repeated on different days, and were carefully controlled for sterility of the media of exposure and of glassware, for the purity of the cultures used and for positive untreated organism transfers. The results of these tests for meroxyl are expressed in Table I. Turning to this table, one is struck at once with the fact that at the end of exposures lasting 1 to 5 minutes, the germicidal power of the drug for bacillus coli is very high, not only in salt solution, but equally so in urine and 50 per cent dog serum. It is, therefore, demonstrated that for these periods the germicidal power of the drug is not diminished in the presence of albumin or urine, a most important factor in the clinical use of antiseptics. This is not true of many other germicides. At the end of an hour the inhibiting effects of serum and urinary constituents become apparent, although this is more evident in the case of staphylococcus than of bacillus coli. Table I alone is sufficient to point out the probability of great clinical value for meroxyl.

Table II shows the comparative bactericidal values of mercurochrome and meroxyl.

We have chosen mercurochrome to be compared with meroxyl because mercurochrome is a related mercurial of established value, which has been studied in the same general way. An analysis of Table II shows the high germicidal strength of meroxyl for pyocyaneus and bacillus pneumoniæ. The table is also instructive as demonstrating the marked inhibition produced by the serum upon antiseptics in one hour tests.

Table III gives the bactericidal value of various drugs against the colon bacillus in 50

TABLE III—BACTERICIDAL VALUE OF DRUGS AGAINST BACILLUS COLI IN SERUM AND SALT SOLUTION

Drug	Strength injectable in urethra	Serum, 50 per cent				Sodium chloride solution			
		Killing strength 1 minute	Therapeutic factor— 1 minute	Killing strength 1 hour	Therapeutic factor— 1 hour	Killing strength 1 minute	Therapeutic factor— 1 minute	Killing strength 1 hour	Therapeutic factor— 1 hour
Phenol	[illegible]	[illegible]	2	[illegible]	4	[illegible]	2	[illegible]	10
Potassium permanganate	[illegible]	[illegible]	0.1	[illegible]	0.1	[illegible]	5	1:20,000	100
Mercuric chloride	1:20,000	1:10,000	0.5	[illegible]	1.5	[illegible]	4	1:1,000,000	50
Argyrol	[illegible]	1:100 fails		1:200	20	1:100 fails		?	
Protargol	[illegible]	1:200 fails		[illegible]	20	1:200 fails		1:8,000	160
Silver nitrate	[illegible]	[illegible]	2	[illegible]	2	[illegible]	2	1:10,000	2
Acriflavine	[illegible]	1:200 fails		1:200 fails		1:200 fails		1:4,000	4
Flumerin	[illegible]	1:100 fails		1:100 fails		1:100 fails		1:8,000	80
Mercurophen	1:4,000	1:1,000	2	[illegible]	25	?		?	
Mercurochrome	[illegible]	1:200	2	[illegible]	6	1:200	2	1:200,000	2,000
Meroxyl	[illegible]	[illegible]	5	1:20,000	100	1:10,000	50	1:200,000	1,000

per cent serum and in salt solution. In this table we have included columns which show as follows: Column 1 gives the strength of the drug which can ordinarily be injected into the urethra with impunity. This may be taken as a fair index of what strength may be employed upon other mucous surfaces, but it is well known that the nose and throat will tolerate far greater strengths than the urethra, and we may add that it is possible to use some of these drugs for one or two applications in much stronger solutions than are here given.

Column 2 shows the germicidal value of the drug, the strength at which the organism kills or fails to kill in one minute. From these two columns a therapeutic factor is derived which indicates the presumptive curative value of the drug when used in dilutions which are commonly employed or may be used for limited periods without injury or pain. This therapeutic factor gives an interesting forecast of the practical value of the drug in treatment, so far as can be deduced from laboratory experiments. It will be noticed that while bichloride of mercury will kill the colon bacillus at a strength of 1:10,000 in 1 minute, it cannot be used as an irrigation stronger than 1:20,000 in the urethra (and generally much weaker than this). Therefore, its therapeutic factor (which is derived by dividing the killing strength by the usable dilution), is less than one (0.5).

In the other columns the same factor is worked out in serum for the one hour tests, and in salt solution for one minute and one hour tests. Four columns of therapeutic factors are therefore presented which show graphically the value of eleven different antiseptics for different lengths of time, in salt solution or serum. It is thus possible to get an idea of the value of the drug for the conditions met with clinically. A survey of the columns giving the therapeutic factor for one minute in serum shows that meroxyl is twenty-five times as effective as any other drug. In fact nitrate of silver, mercurochrome and carbolic acid are the only three which approach within one-twenty-fifth of the value of meroxyl according to this factor in the short exposure of one minute in serum. At the end of an hour the difference is not so great and argyrol, protargol, and mercurophen approach to within one-fifth or one-tenth of the value of meroxyl. In the case of permanganate of potash and nitrate of silver in the presence of serum the effect of the drug is no greater in one hour than at the end of a minute. In other words the chemical reaction between the serum and drug neutralizes the action of the antiseptic almost at once.

The next two columns of factors which give the therapeutic value of the drug in salt solution are not nearly so valuable as the conditions present do not approximate those found in the body. In salt solution all antiseptics are more active, as a result of being freed from the inhibiting action of serum. For example, the albumin in serum reduces potassium permanganate to manganese oxide which is inert. In the case of silver nitrate the chlorides in the serum precipitate the silver at once as

TABLE IV.—BACTERICIDAL VALUE OF DRUGS AGAINST STAPHYLOCOCCUS AUREUS IN SERUM AND SALT SOLUTION

Drug	Strength injectable in urethra	Serum 50 per cent				Sodium chloride solution			
		Killing strength 1 minute	Therapeutic factor — 1 minute	Killing strength 1 hour	Therapeutic factor— 1 hour	Killing strength 1 minute	Therapeutic factor— 1 minute	Killing strength 1 hour	Therapeutic factor— 1 hour
Phenol	1:50	1:100 fails		1:100	2	1:100 fails		1:400	8
Potassium permanganate	1:2,000	1:100	0.05	1:100	0.05	1:1,000	0.5	1:100,000	50
Mercuric chloride	1:20,000	1:3,000	0.15	1:9,000	0.45	1:40,000	2	1:1,000,000	50
Argyrol	10%	1:100 fails		1:100	10	1:100 fails		1:10,000	1,000
Protargol	2%	1:200 fails		1:900	18	1:200 fails		1:4,000	200
Silver nitrate	1:5,000	1:3,000	0.6	1:3,000	0.6	1:4,000	0.8	1:4,000	0.8
Acriflavine	1:1,000	1:200 fails		1:200 fails		1:200 fails		1:3,000	0.75
Flumerin	1:100	1:100 fails		1:100 fails		1:100 fails		1:5,000	50
Mercurophen	1:4,000	1:10,000	2.5	1:30,000	7.5	?		?	
Mercurochrome	1:100	1:90	0.9	1:200	2	1:100	1	1:500,000	700
Meroxyl	1:200	1:600	3	1:2,000	10	1:600	3	1:700,000	2,000

insoluble silver chloride, but this is true also in salt solution, so that the results with nitrate of silver are the same in serum and in salt solution, with a very low therapeutic factor, viz., 2, in each.

In salt solution meroxyl again shows its superiority both for 1 and 60 minute tests over all drugs except mercurochrome, which equals it in 60 minute tests. Owing to the great penetration of the stain and its lasting effect, after several days, mercurochrome is probably more valuable as an antiseptic than meroxyl in certain cases, especially in those cases such as external wounds, skin surfaces and glandular organs where penetration and prolonged action are desirable.

Table IV is similar in every respect for the same drugs tested against staphylococcus pyogenes-aureus, and the results obtained are very similar to those mentioned above for the colon bacillus. It is evident, however, that meroxyl is proportionately more powerful against the colon bacillus than against the staphylococcus. It is noteworthy here that next to meroxyl mercurophen is the most active antiseptic in serum for one minute exposures with the staphylococcus, and next in order is mercurochrome. But here again the question of permanent and lasting effect is not shown by the tables, and this, after all, is one of the most important questions in practical application of antiseptics to wound surfaces and deep mucous cavities and in the treatment of glandular organs where absorption and deep penetration is desirable.

The gonococcus tests were made by the Swartz and Davis[1] method of which they describe briefly as follows:

"One cubic centimeter of the emulsion is pipetted into a centrifuge tube of diluted drug. The tube is placed in the water bath at 37.5° C. for 18 minutes. At the end of this time, it is centrifuged at high speed for 2 minutes. The supernatant fluid is poured off, and a quantity of salt solution pipetted in. This makes the complete time of action of the drug 20 minutes. The tube is then spun a second time and the wash fluid poured off. The gonococci settle readily in the centrifuge tube and form a compact mass at the tip of the tube, which can be transferred almost *en masse* to a tube of fresh media. This is corked and incubated, as described by Swartz. It is our custom to inoculate after 7 days all tubes upon which no growth has occurred with fresh cultures of gonococci. If they develop, we assume that enough of the drug has not been carried over to the test medium to prevent growth. All final growths are examined microscopically with the Gram stain."

The 5 minute gonococcus tests were made by the same method. The results of the meroxyl gonococcus tests are expressed in Table V where, with the exception of the acriflavine, mercurophen and meroxyl tests, the figures of Davis and Swartz are quoted.[2]

On analyzing Table V, it is proper to state that the technique of carrying out bacteriological and germicidal tests upon the gonococcus is far more difficult than with the organisms previously mentioned. The gonococcus being a much more delicate organism, the conditions of the experiment have to be made somewhat

[1] Swartz, E. O., and Davis, D. M. The action on the gonococcus of various drugs commonly used in the prophylaxis and treatment of gonorrhea. J. Urol., 1921, v, 235–247.
Swartz, E. O., and Davis, D. M. Action of mercurochrome 220 on the gonococcus. J. Am. M. Ass., 1921, lxxvi, 844–846.

[2] *Loc. cit.*

TABLE V.—BACTERICIDAL VALUE OF DRUGS AGAINST THE GONOCOCCUS IN WEAK SERUM

Drug	Strength injectable in urethra	Killing strength 20 minutes	Therapeutic factor 20 minutes	Killing strength 5 minutes	Therapeutic factor 5 minutes
Meroxyl	1	1:80,000	400	1:40,000	200
Pot. Merc. Iodide	1	1:40,000	200		
Mercurophen	1	1:40,000	200		
Mercurochrome	1	1:2,000	10	1:4,000	40
Acriflavine	1	1:8,000	40		
Chlorazene	1:400	1:2,000	5		
Potassium permanganate	1:2,000	1:2,000	1		
Argyrol	10%	1:800	80		
Cargentos	1%	1:800	80		
Silrol	10%	1:400	40		
Protargol	2%	1:400	8		
Phenol	2%	1:400	4		
Boric Acid	2%	1 in 5			
Zinc Sulphate	1%	1 in 5			

TABLE VI.—TREATMENT OF GONORRHŒA (ACUTE ANTERIOR) WITH MEROXYL; 0.5 PER CENT INJECTED FOUR OR FIVE TIMES PER DAY

	Cases	Per cent
G. C. absent from in 1 to 5 days	2	6.9
6 to 10 days	1	3.45
11 to 15 days	4	13.8
16 to 20 days	1	3.45
21 to 30 days	1	3.45
26 to 30 days	0	
28 to 31 days	1	3.45
Total apparently cured	10	34.5
Did not return 2nd time	5	17.25 (some may have been aborted)
Discontinued treatment after 14, 17, 20, 49, 19, 11 days, G. C. still present.	7	the failures
Complications:		
Posterior urethritis	3	10.3
Epididymitis and prostatic abscess	1	3.45
Peri-urethritis	1	3.45
Total complications	5	17.2
Total cases	29	

different and the antiseptics are subjected to contact with a greater number of organisms.[1] Owing to the necessity of separating the organisms in the centrifuge, it is impossible to obtain one minute tests and the five and twenty minute exposures are therefore adopted. Here again the therapeutic factor has been worked out and again meroxyl is shown to be far more germicidal than all the others; the next in order being mercurochrome. Argyrol shows a very high therapeutic factor owing to the fact that it can be used in high concentration, and the same is true of some of the other silver compounds, although their killing strength is low. The question arises, however, whether these colloidal drugs existing as suspensions of comparatively large particles have as great penetration as the other aqueous solutions, particularly those which have the character of stains, as acriflavine and mercurochrome. The high therapeutic value of potassium mercuric iodide is of interest, as has been shown by one of us in a previous paper. As regards gonococcal infections it seems evident that in several of these new antiseptics, and particularly in meroxyl, agents which may have great value are at hand. While most of these drugs produce little or no irritation at the strength mentioned, practical experience shows that all urethral injections and irrigations should be used fairly dilute; e.g., while acriflavine can be used at the strength of 1:1,000 without much irritation, E. G. Davis recommends that it be used in a strength of 1:8,000.

Meroxyl, as judged by laboratory tests, is a drug of particularly high germicidal value against the gonococcus and against bacillus coli. The high germicidal value of mercurochrome is well known; yet, compared with mercurochrome against the gonococcus, meroxyl is four times as effective in the 5 minute tests, and five times as effective in the 20 minute tests. Moreover, meroxyl is the strongest gonococcicide which has been tested to date by this method. Against bacillus coli, meroxyl is at least 150 times as germicidal as argyrol, and is equaled by mercurochrome only in the one hour tests in salt solution. In urine, meroxyl is twelve times stronger than mercurochrome in one minute exposure, twenty times as strong in five minutes, and fifteen times as strong in one hour. While of marked germicidal value against staphylococcus pyogenes aureus, meroxyl does not seem to exert as strong an action against these organisms as against the three genera of bacilli against which it has been tested. Compared with other drugs commonly used as germicides, meroxyl falls into the group of the most powerful, that is, it is comparable to bichloride of mercury, and to silver nitrate in its action in 50 per cent serum in 1 minute. Although too close a comparison must not be drawn between the action of a drug *in vitro*, where penetration is assured, with its action *in vivo*, where pene-

[1] [illegible] J. Infect. Dis., 1922, xxxi, 521-[illegible].

TABLE VII.—PROPHYLACTIC USE OF MEROXYL TO PREVENT CATHETER FEVER AND INFECTIONS

Patient	No.	Operation	Strength of solution	Frequency	Remarks
S. C.	5730	Perineal prostatectomy	0.5%	t.i.d. 4 days	In catheter (before oper.) and drainage tube (after oper.); urine was sterile at all times, and on discharge of patient.
O. P. H.	9970	Perineal prostatectomy	0.5%	t.i.d. 4 days	In catheter (before oper.) and drainage tube (after oper.); urine sterile at all times, and on discharge of patient.

In a few other cases, with urine sterile at the time of admission, similar measures did not keep it so.

tration, distribution of organisms and other variations must be considered, such a high experimental bactericidal value should justify the clinical trial of meroxyl.

CLINICAL EXPERIENCES WITH MEROXYL

Open infected wounds present excellent opportunities for studying their bacterial content, and on this account an effort has been made to investigate the germicidal value of meroxyl in such wounds. We have endeavored to do so, following as closely as possible the methods employed by Carrel, Dakin, and their associates.

Through the kindness of Dr. Halsted, a series of wounds in the surgical wards and in the surgical out-patient department of the Johns Hopkins Hospital has been studied bacteriologically. Dr. Wm. Rienhoff has had charge of the treatment of these cases. The treatment has usually consisted of irrigation with a 0.5 per cent meroxyl and the application of an ointment containing 1 per cent meroxyl. The clinical notes of twelve cases are given herewith in brief.

REPORT OF CASES IN WHICH MEROXYL WAS USED IN WOUNDS[1]

Case 1. G-65782. Carbuncle of lower jaw with glands. Opened June 5, 1922; drained, irrigated well with meroxyl, 0.5 per cent. Next day again irrigated and dressed with meroxyl ointment. Count 25 bacteria per microscopic field.[2] Daily application of meroxyl sterilized wound in 3 days. Area healed in 3 weeks.

Case 2. G-65873. Infected laceration of leg 1 week old; draining pus, count 8 per field, when irrigated with meroxyl 0.5 per cent and dressed daily with meroxyl ointment 1 per cent. Sterile in 5 days and healed in 11.

Case 3. G-65591. Infected finger following splinter, with lymphangitis and axillary adenitis. Incised, drained. Irrigated daily with meroxyl 0.5 per cent and dressed with meroxyl ointment. Count dropped in 24 hours from 37 to 5 per field. Dressed with boric acid, and count rose to 18 per field. Then healed after 2 weeks.

Case 4. G-64862. Infected finger. Incised and drained. Count before treatment over 100 per field. Ointment and solution used; wound drained pus. Dressings made every second day. In 18 days count 3 per field.

Case 5. G-64453. Infected stump of amputated finger. Wound count at start 8 per field. Dressings every second day; drained pus. Wound count after 12 days 2 per field. Healed in 26 days.

Case 6. G-64329. Infected finger. Dressed from May 8, 1922, to June 6, 1922, with boric ointment, etc. Wound count June 6, 1922, 10 per field. Sterilized in 9 days with meroxyl solution and ointment. Wound healed in 25 days.

Case 7. G-64103. Palmar abscess 1 week old. Incised and drained every second day; meroxyl irrigations 0.5 per cent. Count June 24, 1922, 8.4 per field; count June 26, 1922, 2.6 per field. Sterile in 6 weeks; ointment also used.

Case 8. G-61718. Palmar abscess and infection of tendon sheaths, postoperative. Persistent drainage with formation of exuberant granulations from April until May 20. Count May 27, 15 per field; count June 12, 1 per field after meroxyl treatment. Healed by June 27.

Case 9. G-49127. Bone felon, operated. Count May 25, 1922, 15 per field; May 27, 1922, 2 per field; May 29, 1922, 3/10; healed June 12, 1922.

Case 10. G-50354. Luetic ulcer, secondarily infected. Count May 23, 1922, over 100 per field; count June 22, 1922, 8 per field.

Case 11. G-51331. Carbuncle of abdominal wall. June 16, 1922. Incised, drained; meroxyl irrigations and ointment. Sterilized by June 24, 1922, and healed 1 week later.

[1] Preparation of ointment: Two grams of the powder (containing 1 gram of pure substance) is dissolved in 10 cubic centimeters of hot water. The solution or the gel forming as the solution cools, is incorporated with 90 grams of lanolin by very thorough mixing. An even, permanent ointment results.

[2] In making wound counts the method of Carrel has been employed. Smears were fixed by heat, stained ½ minute with carbolthionin, washed in water, and examined with No. 10 ocular and 1.9 mm. oil immersion lens. Five fields were counted on heavily infected smears, 10 on moderately infected, and 20 on slightly infected smears. In the fractions used, the denominator indicates the number of fields counted, and the numerator the total number of organisms observed. Carrel, A., and Dehelly, G. The Treatment of Infected Wounds. Translation by H. Child. New York: Paul B. Hoeber, 1917, page 155.

TABLE VIII.—WET DRESSINGS OF WOUNDS WITH MEROXYL

Patient	N	Operation	Strength of Solution	No. of days	Remarks
Wm. B.	1567	Hypospadias (straightening of penis), 1st stage.	0.5%	19 days	Slight infection, rapid healing.
J. P. H.	10144	Varicocele	0.5%	5 days	Slight infection, rapid improvement.
D. M. C. C.	9952	Hypospadias (straightening of penis), 1st stage.	0.5%	12 days	Tiny stitch abscess. Healed quickly.
A. B.	6809	Carcinoma of penis. Radical operation.	0.5%	11 days	Mild ptyalism. Later dressings with 1:1,000 gave no reaction. Healed well.
C. W.	7511	Hypospadias, 3rd stage. Cure of small fistula.	0.5%	16 days	Slight infection, rapid healing.
Wm. G.	11413	Hypospadias (straightening of penis), 1st stage.	0.5%	12 days	Slight infection, rapid healing.
L. P.	11151	Carcinoma of penis. Radical operation.	0.5%	22 days	Some sloughing of skin edges. Dakin's for 10 days, then meroxyl. Satisfactory healing.
H. P.	11170	Carcinoma of penis. Radical operation.	0.5%	35 days	Some slight superficial infection; healed in 30 days.
G. R.	10189	Radical oper for tuberculosis of genital tract.	0.5%	14 days	Very favorable healing.
C. R.	10185	Hypospadias (straightening of penis), 1st stage.	0.5%	9 days	Slight infection, rapid healing.
B. F. L.	11124	Hypospadias (straightening of penis), 1st stage.	0.5%	14 days	Small area of pressure necrosis from suture. Rapid healing.
G. H.	11245	Carcinoma of penis. Radical operation.	1:4,000	6 days	Dakin's irrigations after necrotic area appeared. Healing in 38 days.

It is obvious that all the wounds in this table healed uninterruptedly. Dakin's solution was used for a time in cases where quantities of necrotic tissue were present. A case of mild ptyalism was taken to indicate that a 0.5 per cent solution was somewhat too strong. A 1:1,000 solution is equally effective.

An analysis of the above series shows that in about 50 per cent of the cases the wound became sterile in from 3 days to 2 weeks, with the exception of one case which required 6 weeks, and in other cases the count dropped to from 1 to 5 bacteria per field, which is very low, according to the data obtained in army hospitals. Such cases could easily be operated upon or skin-grafted. While the above series is small, it is sufficient to show the bactericidal effect of meroxyl in tissues, and demonstrates also that wound healing is not impaired, and that epidermization is not interfered with. As a result of further experiences some of us are convinced that the drug may be used in distinctly weaker solution and that 0.5 per cent is not necessary to obtain sufficient germicidal effect. In a much longer series of wounds where it was impossible to carry out bacterial counts our clinical experience has been that badly infected wounds clear up under irrigations of meroxyl 1:1,000 very satisfactorily.

DISCUSSION

Meroxyl has also been used in the urological wards of the Johns Hopkins Hospital in a great variety of ways. Its great germicidal power and its non-staining and non-irritating properties, lead one to apply it frequently. These uses are classified in the accompanying tables, and may be discussed seriatim.

1. Irrigation of infected kidney pelvis. When an infected pelvis is opened at operation, it would seem that some means should be adopted to attempt to cure the infection while drainage is going on. It is often felt that ordinary pelvic lavage through a ureteral catheter fails because of the necessarily infrequent applications. Through a small tube laid in the pelvis at operation frequent lavage, or even continuous irrigation, can be carried out. This procedure has been adopted in three cases. In one case, diminution of pus and organisms was observed, but in the other two no improvement. A 1:1,000 solution of meroxyl was used. The most reasonable explanation of this failure is that the constant presence of a foreign body in the wound of the pelvis prevents sterilization. Further experiments must be made, however, before so promising a method is abandoned.

2. Treatment of acute gonorrhœa. In this series, a system of frequent injections (five times a day) was adopted. The patients used the solution at home, and were instructed to retain it in the urethra for 5 minutes. One-half of one per cent meroxyl was used. To the table as given should be added another recent case where an acute gonorrhœa was

TABLE IX.—IRRIGATION OF INFECTED WOUNDS WITH MEROXYL

Patient	No.	Operation	Strength of solution	Frequency	Remarks
Wm. C.	9987	Nephrolithotomy	0.5%	1 x d	Wound infected from kidney. Opened for 2 inches. 24 days treatment. Healed in 40 days.
C. F.	9993	Peri-urethral abscess	1:2000	q. 3 h.	10 days. Healed in 37 days.
R. W. T.	10066	Sinus from infected kidney	1:1000	t.i.d.	Improved, not healed in 14 days. Nephrectomy later.
W. J.	10081	Urinary extravasation	1:1000	q. 2 h.	Dakin's for 10 days until gangrenous tissue had gone. Skin graft 13th day. Healing 50 days. Very good result.
G. C.	10082	Epididymectomy for tuberculosis bilateral.	0.5%	q. 4 h.	Healed well; sinus still present at discharge little drainage. 14 days.
F. G. W.	10105	Peri-urethral and prost. abscess	1:2000	q. 2 h.	20 days. Rapid healing. Small sinus on discharge.
G. C.	9909	Nephrectomy for tuberculosis	1:1000	3 x d.	Wound broke down completely. Under irrig. healed up to 1½ in. in 50 days.
M. L.	10089	Perineal prostatectomy	0.5%	1 x d	Wound separated. Healed in 35 days.
O. McG.	9936	Nephrolithotomy	0.5%	q. 1 h	Slight sore mouth 11th day. Had had same before oper. Changed to boric. Almost healed in 30 days.
E. O.	9914	Perineal prostatectomy	0.5%	3 x d	Wound separated. Not yet healed in 40 days. Very indolent.
M. S.	9853	Nephrectomy for tuberculosis	1:1000	q. 3 h.	Wound broke down. Slight ptyalism. Healed slowly; 1 cm. long in 46 days.
J. T.	9888	Perineal prostatectomy	0.5%	3 x d.	Wound separated when repacked for hæmorrhage. Healed in 45 days.
L. T.	10010	Prostatic abscess	0.5%	q. 1 h.	Healed in 27 days completely.
A. T.	10062	Perineal prostatectomy	0.5%	3 x d.	Wound separated. Healed in 60 days.
F. J. M.	10203	Nephro-ureterectomy	0.5%	Once	Small abscess. Ptyalism and diarrhœa due to one too forceful injection.
M. W.	10103	Nephrectomy for tuberculosis	0.5%	t.i.d.	10 days. Received also Dakin's and ultra-violet light. Complete separation. No healing in 11 weeks.
A. C. S.	10104	Radical oper. for tumor of testicle.	1:1000	q. 4 h.	18 days. Also had Dakin's for 9 days at first. Wound badly infected. Healed in 36 days.
E. S.	10189	Nephrectomy for tuberculosis	0.5%	b. d.	20 days. 25 c.cm. followed by 150 c.cm. salt sol. through tube. Wound did not break down. Very satisfactory result.

It is difficult to draw definite conclusions from this table. Wounds breaking down after nephrectomy for tuberculosis are known to close very slowly. Under meroxyl the bacterial counts of these wounds were reduced, and they healed steadily if slowly. Other wounds healed favorably.

aborted by three injections in one day. In one case it was noted that shortly after an injection of meroxyl, no organisms could be found in the urethral pus, while they were still present in the pus in the third glass of urine, and the urethral pus became reinfected. Meroxyl is the most powerful gonococcicide available, but it is evident that it, like other drugs is unable to reach all the gonococci in many cases.

3. Prophylaxis of urinary infection. Meroxyl has been very freely used for irrigating catheters and drainage tubes, for instillations and irrigations before and after instrumentation, and for injection through ureteral catheters just before removal. It is our impression that a great many infections are so prevented, though statistics are difficult to gather. An instillation of meroxyl before and after the use of sounds has prevented chills in patients where they have invariably occurred on previous occasions. Two patients wearing retention catheters have been kept sterile for four days preceding operation by frequent irrigations with meroxyl.

4. Wet dressings for wounds. Wet dressings have been adopted for many wounds where infection was especially feared, as in hypospadias cases, where small uncovered areas or drains were present, when skin grafts were used, or where separation of the skin edges occurred. Where any necrotic tissue is present, Dakin's solution is preferable, as meroxyl does not dissolve the sloughs nor is it a deodorant. After the wound has become clean it is our practice to substitute meroxyl for Dakin's solution. It can be said that all the wounds treated with meroxyl healed uninterruptedly, and no spread of infection occurred.

5. Irrigation of infected wounds. In wounds where deep infection is present it is our custom to irrigate with meroxyl solution except, as mentioned above, where necrotic tissue is present, when Dakin's solution is preferable. Many of the wounds so treated were cases

TABLE X.—INSTILLATIONS OF MEROXYL FOR CYSTITIS

[illegible]	[illegible]	[illegible]	[illegible] of Instillation	Frequency	No. of days	Remarks
C. J. E.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	No marked improvement in urine, but frequency and burning relieved. Also received hydraulic dilation.
J. H. J.	[illegible]	Acute cystitis	[illegible]	[illegible]	50 days	Improvement in urine, frequency and burning improved. Also received hydraulic dilation. Area of interstitial cystitis found before discharge.
W. E. H.	[illegible]	Chronic cystitis	[illegible]	q. d.	14 days	Cured. Urine sterile on discharge.
[illegible]	[illegible]	Chronic cystitis	[illegible]	b. d.	6 days	Had bladder polyp removed. Urine sterile on discharge.
A. H.	[illegible]	Chronic cystitis in paretic bladder	[illegible]	b. d.	12 days	Also received argyrol. Slightly improved; not sterilized.
E. B. G.	[illegible]	Chronic interstitial cystitis, [illegible]	[illegible]	[illegible]	4 days	Also received argyrol and 220. No improvement. Death.
M. A. S.	9975	Chronic pyelitis and cystitis, diabetes	[illegible]	t.i.d.	6 days	No improvement. 220, 1% lavage to kidney. Pyelonephritis, death.
Wm. O.	[illegible]	Chronic cystitis and contracted vesical orifice	[illegible]	t.i.d.	[illegible]	Punch oper. Great improvement at end of 5 days. Few wbc. and occasional coccus in urine.
A. H. A.	[illegible]	Chronic cystitis and contracted vesical orifice	[illegible]	t.i.d.	4 days	Punch oper. Also received 220. Great improvement at end of 10 days. Some pus but no organisms.
J. C. F.	[illegible]	Interstitial cystitis	[illegible]	[illegible]	70 days	Also received hydraulic dilation. No improvement in urine.

This table includes various kinds of cystitis. No case of so-called interstitial cystitis showed any improvement not referable to hydraulic dilation. Ordinary chronic cystitis showed improvement.

where a tuberculous kidney had been removed, or where pus or infected urine had contaminated the incision. The results in general have been satisfactory, all non-tuberculous wounds healing uninterruptedly, Tuberculous wounds are kept clean, but the healing is not noticeably hastened. No retarding effect on granulations has been observed. There is never any irritation of the skin as with Dak'n's solution. In one case where an injection of 0.5 per cent solution was made too forcibly, pain and vomiting occurred but no unfavorable after-effects followed. In two other cases there was slight salivation after prolonged use of a 0.5 per cent solution. A 1:1,000 solution is entirely satisfactory and equal to 1:1,000 bichloride of mercury in germicidal value. All perineal prostatectomy wounds have been washed with 0.5 per cent meroxyl as a routine for some time. During this period 89 cases have been so treated, and in only four did the sutured portion of the wound fail to heal *per primam*. These all healed satisfactorily by second intention under a continuation of the irrigations, as did the drainage tracts in the other 85 cases.

6. *Treatment of chronic cystitis*. These cases divide themselves into two groups: the so-called interstitial cystitis, and ordinary chronic cystitis. No favorable effect was observed in the cases of interstitial cystitis, as was to be expected. Other cases all showed marked improvement or cure.

7. *Treatment of postoperative cystitis*. Cystitis almost invariably follows operations involving the bladder, and a method of treatment enabling one to overcome this complication would be a tremendous advance in urological surgery. The results in 36 cases treated with meroxyl are shown in Table XI. It should be stated that in many cases it was impossible to continue the treatment as long as desired since the patients, feeling quite well, wished to return home. In spite of this, however, the results were very satisfactory since, in a majority of cases, the urine, if not sterilized, was improved and often made macroscopically clear. In two of the six cases showing no improvement, diverticula were demonstrated in the bladder. In our clinic it is now not unusual to sterilize the bladder within a month after perineal or suprapubic operations.

We feel that meroxyl is an invaluable drug for the urologist, especially for its effects in preventing infection and in the treatment of cystitis. As an irrigation for infected wounds, it has proved its usefulness both bacteriologically and clinically. We have of course met with many failures to sterilize the urine in

TABLE XI.—INSTILLATIONS OF MEROXYL FOR POSTOPERATIVE CYSTITIS

Patient	No.	Operation	Urine before operation: Pus	Urine before operation: Organisms	Strength of solution	Frequency	No. of days	Urine before instillation: Pus	Urine before instillation: Organisms	Urine after instillation: Pus	Urine after instillation: Organisms	Remarks
B. B.	10081	Perineal prostatectomy	+	+	1:1,000	t.i.d.	3 days	+++	+ -	+		Great improvement. Cure?
J. C. K.	10[illegible]	Perineal prostatectomy	++	++	1:1,000	t.i.d.	3 days	++	-	+	+	Improvement.
H. McC	10078	Nephropexy	-	-	1:1,000	t.i.d.	1 day	- - -	-			Cured.
J. W. S.	10079	Repair int. and ext. sphincter	+++	++	1:1,000	t.i.d.	10 days	++	++	-	bac.	Bacilluria reduced.
J. G. P.	10[illegible]	Nephrectomy (chronic pyelonephritis.)	- -	++	1:500	1 x day	3 days	+	+			Cured.
A. W.	10[illegible]	Perineal prostatectomy	++	+	1:1,000, 1:[illegible]	2 x day	2 days	++	-	?	?	Left before specimen could be examined.
S. L.	10082	Perineal prostatectomy	+	+	1:1,000	q. 4 h.	11 days	+++	-	+		Clear on several occasions.
D. D.	10118	Perineal prostatectomy (stones)	+	++	1:1,000	1 x day	4 days	++++	-	+	+ few	Frequency and burning disappeared.
C. V. N.	09978	Perineal prostatectomy	+++	- - -	1:1,000	q. 4 h.	6 days	+	+	+	+ few b.	Also received 220 three days 1 per cent. Great improvement.
M. S.	09855	Nephrectomy for tuberculosis	++	+	1:1,000	q. 4 h.	1 day	+ few		Occ. wbc.		Cured.
M. W.	09847	Suprapubic prostatectomy			1:2,000	q. 4 h.	12 days	-	-	-		Persistent fistula and cystitis. Cure, fistula closed.
J. R.	10118	Perineal prostatectomy	+++	+	1:2,000	q. 4 h.	5 days	++	-	+	+	Marked improvement in gross appearance of urine
C. H.	12017	Suprapubic lithotomy	- -	+	1:1,000	q. 4 h.	3 days	++	-	+	few	Marked improvement. Macroscopically clear.
W. M.	10031	Perineal prostatectomy	++	++	1:[illegible]	2 x day	2 days	++	-	+	Occ.	Marked improvement.
H. W.	10081	Suprapubic lithotomy Punch operation	+	+	1:1,000	q. 4 h.	1 day	+	Occ.	few	+	Epididymitis. instillations discontinued without improvement.
G. R.	10150	Radical operation for tuberculosis genital tract	+++	few	1:1,000	b. d.	14 days	++	Occ.	few	Occ. bac.	Frequency and burning disappeared. Some improvement.
N. K.	10126	Perineal prostatectomy	-	few	1:1,000	2 x day	2 days	++	+	very few wbc.	Occ. bac.	Great improvement.
T. T.	10091	Perineal prostatectomy	-		1:500	2 x day	4 days	++	+	few wbc.	Occ. bac.	Great improvement.
W. P. T.	09121	Perineal prostatectomy	++	+	1:200, 1:1,000	q. 4 h.	4 days	- -	-	++	+	Frequency and burning disappeared. Also had [illegible]
W. J. C.	10206	Perineal prostatectomy	++	+	[illegible]	q. 4 h.	1 day	+	+	+		Great improvement.
A. T.	10262	Perineal prostatectomy	few	+	1:500	2 x day	1 day	++	+	+	+	Some improvement
Wm M.	12173	Perineal prostatectomy	few		1:1,000, 1:200	2 x day	7 days	++	+	+	Occ. bac.	Marked improvement.
J. B. C.	10023	Perineal prostatectomy (stones)	++	+	1:200, 1:1,000	q. 4 h.	4 days	++	+	++	very few	Some improvement
J. F. E.	10022	Perineal prostatectomy	+	+	1:[illegible]	2 x day	3 days		+	+	+	Urine not improved but dysuria cured.
J. Z. W.	10050	Perineal prostatectomy.	few		1:1,000	q. 4 h.	4 days	++	+	+	Occ.	Great improvement.
G. F. E.	10233	Perineal prostatectomy	+	+	1:[illegible]	2 x day	2 days	++	+	++		Epididymitis. No improvement.
J. J. J.	10168	Perineal prostatectomy	+	+	1:[illegible]	2 x day	2 days	++++	++	+++		Little improvement.
R. A. S.	10468	Perineal prostatectomy	few	+++	1:[illegible] 1:500 1:200	2 x day	2 days	++++	++	++ +	++	Numerous cocci and bacilli and diverticulum.
J. A. A.	10435	Perineal prostatectomy	++++	few	1:1,000, 1:500	2 x day	2 days	++	++	++		No improvement. Diverticulum.
J. B.	10150	Perineal prostatectomy	++	++	1:1,000, 1:500	2 x day	2 days	++	- -	-	+	Some improvement. Bacilli decreased.
W. A. W.	10389	Perineal prostatectomy			1:1,000, 1:500	2 x day	2 days		++	+	Occ. bac.	Marked improvement. Cocci eliminated; only occasional bacillus.
F. H.	09650	Radical cure of epispadias	-	-	1:4,000	b.d.	14 days	+	-			Cured.
J. F.	10535	Perineal prostatectomy	-		1:1,000, 1:500	2 x day	2 days	+++	++	+++	Occ.	Marked improvement.
S. H.	10415	Perineal prostatectomy	++	++	1:[illegible] 1:500 1:200	2 x day	2 days	-	+++	+++	+++	No improvement.
H. D.	10302	Perineal prostatectomy	+	++	1:[illegible] 1:500	2 x day	2 days	+	+	+	Occ.	Marked improvement.
J. S.	10425	Perineal prostatectomy	+++	++	1:[illegible] 1:500 1:200	2 x day	4 days	+++	+++	+++	+++	No improvement.

This table shows mostly cases of cystitis after perineal prostatectomy. It will be seen that most of them were infected at the time of admission. The results may be classified as follows: Total cases, 36; cured (sterilized) 5 cases, 14 per cent; infection markedly improved 14 cases, 39 per cent; somewhat improved 10 cases, 28 per cent; not improved 6 cases, 16 per cent; no record 1 case, 2.8 per cent. Cured or improved 20 cases, 80 per cent. The technique finally adopted comprised 5 instillations a day, of about 30 c.cm. each. Each day of instillations is followed by a day of rest. The first day, a 1:1000 solution is used, the second, 1:500, the third and subsequent days, 1:200, unless too much irritation is caused, when one of the weaker solutions is resumed. In many cases atropin gr. 1/120 dissolved in a little water is injected 5 minutes before the instillation "to prevent reverse peristalsis of the vasa deferentia."

cystitis, but in some of these cases deep-seated infection of prostate, seminal vesicles or kidneys was present, while in others diverticula or cellules harbored the organisms. At present we seem to get the best results in cases with prostatic infection by irrigating the bladder by hydraulic pressure without a catheter with 1:2,000 meroxyl, and then injecting the urethra and bladder with 0.5 per cent mercurochrome. Prostatic massage two or three days later will usually show the cells stained deeply pink.

MEROXYL IN OTHER SPECIALTIES

We have furnished meroxyl in considerable quantity to specialists in other lines of work, particularly in otolaryngology and ophthalmology, and from time to time have had reports indicating very satisfactory results. Dr. Samuel J. Crowe has given us the following report of the experience with meroxyl of the department of otolaryngology of the Johns Hopkins Hospital:

Since the introduction of meroxyl in January, 1921, this antiseptic has been largely used in treating affections of the ears, nose and throat in the Johns Hopkins Hospital and dispensary.

We feel that the value of this drug has been clearly demonstrated. For most purposes it is superior to the silver preparations and is equally as good, if not better than its predecessor, mercurochrome. The latter is preferable in cases where penetration is especially desired; but the fact that meroxyl does not stain and is at the same time more germicidal than mercurochrome renders it the solution of choice in treating the nose and ears. Silver nitrate is almost indispensable in this special field of surgery but we find that better results are often obtained when meroxyl is used in conjunction with this drug.

We give below a few isolated cases in which we have obtained excellent results with meroxyl:

In chronic suppurative otitis media in which there is a large perforation in the drum, we have often been able to clear up the discharge temporarily, but as there is almost always an infection of the mastoid, nothing short of an operation really cures the condition. In these cases the best results are obtained by filling the ear with a 0.5 per cent or even weaker solution and then catheterizing the Eustachian tube and passing a whalebone bougie. When this is withdrawn, it draws some of the solution down the tube. The meroxyl can also be injected into the catheter and forced up the tube into the middle ear. We have been able to clear up one case of subacute suppurative otitis media in which the drum had been incised on five occasions, a hæmolytic streptococcus being present. The clinical examination and the X-ray showed a definite infection of the mastoid, although there had been no previous trouble. In this case, following a paracentesis of the drum, the Eustachian tube was dilated and about an ounce of the 0.5 per cent solution was forced up the tube. About a week later the ear had healed and the hearing was normal.

In a few cases of chronic maxillary empyema where the sinus is not filled with polypi, we have been able to stop the discharge by instilling a little 0.5 per cent meroxyl into the antrum after the pus had been washed out with salt solution. In one recent case with an acute antrum infection the condition seemed to clear up quickly after one instillation of 0.5 per cent meroxyl. So many of these cases clear up, however, after a very few irrigations with sterile normal salt solution that it is impossible to arrive at any definite conclusions as regards the acute cases. After operations on the various sinuses we have found meroxyl most useful, either by local application or by instillation through a metal catheter.

On several occasions we have been able to abort an attack of acute rhinitis or pharyngitis by the local application of 0.5 per cent – 1 per cent meroxyl in the nasopharynx and pharynx. In the former condition this is best applied along the floor of the nose. If the cases are treated within 10 to 12 hours after the onset, the results are most favorable. It has been the personal experience of several members of the staff with acute pharyngitis that almost immediate relief is obtained as regards swallowing after a generous local application to the pharynx.

We have not noticed that meroxyl is superior to the other antiseptics in the treatment of acute tonsillitis. It is more soothing than silver nitrate, however, and is probably as good as any.

A very stubborn case of retro-tonsillar abscess which came on about a week after tonsillectomy was seen recently. The operation had been performed elsewhere about three months previously and when first seen there was a deep-pocketed abscess. This did not clear up quickly as they often do after wide incision, but after irrigating a few times, once a day, with 1 per cent meroxyl a cure resulted. The organism in this case was a hæmolytic streptococcus.

These are just a few of the cases in which the results have been most satisfactory. We feel that much more can be accomplished if careful studies are made as to the bacteriology and as to the proper strength of solution to use in the various situations with reference to the stage of the infection.

Dr James Bordley reports in a personal communication that the drug has been efficient in curing several middle ear infections, results which, he recently stated, were quite unusual and which will be reported in detail in a separate paper.

No systematic experiments on the use of meroxyl in the sterilization of diphtheria carriers and other throat infection have as yet been carried out. From our present experience we feel safe in saying that this drug is of value in treating infections of the ear, nose and throat and probably also the eye and in dentistry. The question of the penetration of the drug, which cannot be definitely demonstrated as it can in the case of mercurochrome, is of utmost importance. Meroxyl is undoubtedly a germicide of greater potency than mercurochrome, and therefore probably more effective when the bacteria can be reached by local applications and irrigations; nevertheless the question arises whether mercurochrome or other antiseptic dyes may not be more effective in reaching deep-seated infections, sinuses, glands, etc.

RÉSUMÉ

Further discussion is scarcely necessary as the bactericidal and clinical qualities of meroxyl have been fully enumerated before. It may be well, however, to state here that the fact that antiseptics are now available which show little or no inhibition by serum or urine, is of the greatest importance, and urologists in particular should, in our opinion, seize the opportunity to make use of antiseptics in a prophylactic way far more extensively than in the past. Prevention is the most important field in medicine and nowhere is it more urgently necessary than in urology where such dire results follow urethral, prostatic, bladder, and renal infections which come, only too often, from the common clinical instrumentations and examinations. In our short series of cases we have demonstrated that catheterization even for prolonged periods can be carried out without vesical infection, and that prostatectomies can be brought through to complete healing without infection of the bladder. This, we believe, has not hitherto been accomplished, at any rate, it has not been spoken of in the literature. When we compare the healthful wound conditions now customary in our wards with the distressing infections, often complicated by depositions of urinary salts and by tissue necrosis, which used to be so common, we feel justified in asserting that a new epoch has been opened. When by simple pre-operative and postoperative injections of the urethra, instrumental infections can be effectively prevented, it will become little short of criminal to be indifferent to commonly recurring instrumental infections in a urological service. It is now no uncommon thing to subject a patient to numerous cystoscopies, ureteral catheterizations, functional tests, pyelograms, and operations to remove calculi from the kidney or ureter, the wound being drained, without having an infection either of the urinary tract or of the drained wound during the convalescence.

The details of the technique and the selection of the solution strength for meroxyl in the treatment of wounds and inflamed mucous surfaces have as yet not been fully established. In all probability it can be used effectively in weaker solutions than we have ourselves employed. It is certain that the 0.5 per cent strength is not necessary in urethral and bladder work, although it can be readily used for a limited number of applications. In the same way the frequency of irrigation and other details have not been thoroughly worked out, nor has it been decided which cases can be more satisfactorily handled with meroxyl than with Carrel-Dakin solution or with other standard antiseptics. Sufficient, however, has been done to warrant us in stating that an antiseptic of pronounced value has been produced, for which the prospects of future usefulness in more extended fields are very bright.

CHOLECYSTITIS AND ITS COMPLICATIONS[1]

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THIS study of biliary tract infections has been made with an idea of attempting to clear up certain disputed points in the pathogenesis of cholecystitis and its complications. Some of the experimental work has followed lines that were not new, in the hope, however, that additional light might be thrown on conceptions which at present are in a state of some confusion. Probably the chief value contributed by this report is the emphasis which it places on the importance of the lymphogenous route, not only in the pathogenesis of the complications of cholecystitis, but also in the pathogenesis of cholecystitis itself. New evidence is submitted which indicates that this route is of much greater importance than it has usually been considered to be. The significance of infections of the portal system in general, in relation to cholecystitis, is also sharply portrayed in some of the experimental work. For convenience, this report is considered in six parts. Part I consists of a review of the literature on experimental cholecystitis; in Part II is submitted the experimentation directly concerned with the establishment of experimental cholecystitis and its relation to hepatitis; Part III contains a consideration of cholecystitis in its relation to appendicitis and ulcer; Part IV consists of a review of pancreatitis and its relation to cholecystitis with a report of investigation; in Part V a survey of clinical cases is offered, and Part VI is a general discussion.

Part I

When Louis (1) actually demonstrated, for the first time, the association of gall-bladder changes with typhoid fever, he prepared the way for experimental cholecystitis. About 30 years later (1861), Rokitansky (2) again drew attention to inflammation of the biliary tract in "typhus fever." Hagenmueller (3) then focused attention on this subject by submitting the first monograph on typhoid fever. The discovery of the bacillus typhosus by Eberth (4 and 5) and the confirmation of this discovery by Koch (6) then kindled the enthusiasm which produced, in the following years, the great number of contributions to our present knowledge of gall-bladder disease. Thus it is easily understood how earlier investigation was confined so closely to infections with the typhoid bacillus.

Exceptions to experimentation with bacterial infection are to be found in the reports of those investigators who were at this time (1881) studying the liver. Beloussow (7) in studying cirrhosis, noted, after ligation of the common duct in animals, that the normal golden yellow bile was changed to a pale viscid fluid containing epithelium and necrotic tissue; while the gall bladder was distended, the walls thinned out, but was free from organisms. Netter (8), in Paris, confirmed these observations, stating that ligation of the common duct in animals was followed by acute inflammation of the biliary passages.

Returning to typhoid cholecystitis, Gaffky (9) was probably the first to experiment on animals with typhoid in pure culture. Wyssokowitsch (10), soon after (1886), injected various organisms, including typhoid, intravenously into animals and recovered the organisms in the liver, portal lymphatics, milk, etc. His work was followed by a report of the Fuetterers (11). These men injected bacillus pyocyaneus into the left ventricles of rabbits and recovered this organism in the gall bladder 1½ hours later. Beumer and Peiper (12) experimenting on mice, rabbits, and guinea pigs, injected bacillus typhosus intraperitoneally and intravenously. They concluded that the organisms were transmitted everywhere by the blood stream but that they did not increase greatly in numbers and did not produce the pathology typical of typhoid in the human. Belfanti (13) disagreed, however, and stated that if a sufficient number of bacillus typhosus are injected into animals, the resulting picture is typical of, or similar to, typhoid fever in the human.

American investigators now became interested in typhoid cholecystitis and the works of Blachstein and Welch, of Johns Hopkins, appeared. Blachstein (14) stated that the intravenous injection of typhoid organisms into rabbits was followed by a "chronic affection of the gall bladder," and recovery of the organisms in the gall bladder. He did not mention his percentage of positive results. Welch (15), also injecting bacillus typhosus intravenously into rabbits, produced the same results but stated that only 50 per cent of his inoculations were successful. Charrin and Roger (16), of France, now varied the procedure somewhat and injected bacillus coli into the common duct. After 8 days they found the gall bladder full of pus with disseminated abscesses in the liver. The more virulent organisms produced pericholangeitis with abscesses in the liver.

In 1892, Naunyn (17) published his monumental work, "Klinik der Cholelithiasis." He was the first investigator to demonstrate the pathogenicity of bacillus coli. Injecting this organism into dogs, intravenously, he recovered the bacillus in the gall bladder at autopsy. Naunyn's work marks the new era of cholecystitis when the attention of medical science was centered on gall stones. Labes (18), working in Naunyn's laboratory at Koenigsberg, placed in the gall bladders of dogs various irritative substances (chemicals, quartz, human gall stones, etc.) but never produced gall stones. In his report, he stated that foreign bodies placed in the gall bladder disappeared, and he concluded that gall stones could not be produced experimentally. In this view he was supported by Naunyn. The error of this conclusion was soon demonstrated when Gilbert (19) produced, in the year following the publication of Naunyn's book, the first experimental gall stones. With Dominici (20), Gilbert also reported, in the same year, concretions found in the gall bladders of rabbits with experimental cholecystitis. Hartmann (21) claims priority of discovery for Mignot who, he says, was the first to present definite evidence of experimental gall stones when he read his paper to the Société de Chirurgie on May 19, 1897, demonstrating three stones from the gall bladder of a guinea pig suffering with experimental *bacillus coli cholecystitis*. In this connection it is interesting to note that Mignot himself published his thesis in 1896, in which he stated that he had produced definite, stratified gall stones, concluding that he required for their production an attenuated organism and 6 to 8 months' time. Gilbert preceded Mignot by 3 years and followed his original work with extensive proof. In 1894 he presented, with his co-worker Dominici (23), more experimental evidence and stated that cholecystitis was usually caused by bacillus coli. Four years later he proved the infectious etiology of cholelithiasis (24). He produced, also, a stone from the gall bladder of a dog, following inoculation with bacillus coli. At about this time, Cushing (25 and 26) produced experimental gall stones by inoculation of bacillus typhosus in the gall bladder of rabbits with "maltreatment" of the organ.

It was now that the fate of organisms following their introduction into the body was taken up with new interest. G. Fuetterer recovered staphylococcus aureus in the bile 40 minutes after subcutaneous injection. (The previous experimentation by the Fuetterers (11) was not directly concerned with the earliest time of appearance.) Homén (28) ligated the common duct of rabbits 1 to 2 centimeters above the ampulla and injected bacillus typhosus in the lower third of the duct, below the ligature, producing cholecystitis. The organisms were recovered from the liver. Sirotinin (29) reported the results of very extensive investigation, stating that he had recovered bacillus typhosus in the lungs, liver, and other organs, following experimental injection of this organism into rabbits and guinea pigs. He concluded that the pathological picture produced by this injection was caused by intoxication and was not due to a specific action of the organism. Biedl and Kraus (30), contributing a large amount of experimentation, studied the elimination of injected bacteria by the kidney, liver, and salivary glands. They recovered the staphylococci in the bile 13 to 45 minutes after intravenous injection. G. Fuetterer (31) now reported the results of very exact determinations and proved that bacillus prodigiosus

could be recovered from the bile 2 minutes after portal vein injection. Pawlowsky (32), commenting on a number of reports, believed that the organisms entered the gall bladder from the liver in the blood stream.

A short while ago, a report from this laboratory (33) stated that cholecystitis could not be easily produced by simple injection of organisms into normal gall bladders. Confirmation of this statement is found in the previous work of Ehret and Stolz (34). These investigators injected staphylococci into otherwise intact gall bladders and produced no lesions. They also introduced virulent bacillus coli into the gall-bladder wall causing little or no inflammation, or in their words, "*so war doch von eitriger Cholecystitis absolut nichts festzustellen.*" After injecting organisms intravenously and subcutaneously without results, they ligated the cystic duct and repeated the intravenous injection. This procedure gave definite results and a cholecystitis was produced. Also, after placing quartz stones in the gall bladder, and injecting organisms intravenously, they produced lesions in the gall bladder. These men concluded that both stasis and infection were necessary to produce cholecystitis. That those factors play a major rôle in the causation of gall-bladder disease cannot be doubted. However, the evidence offered by Blachstein and Welch together with the numerous reports and the experimental work submitted later offer crucial evidence that cholecystitis can be produced by intravenous injection without stasis of bile or traumatism of the gall bladder, provided the strain of organism used is of sufficient virulence and is injected in large enough amounts.

Ehret and Stolz (35) in another, a very exhaustive report, present an excellent review of the early literature and offer unquestionable proof that the mere injection of organisms into the normal gall bladder will not usually cause cholecystitis. They say in their report that the biliary tracts of guinea pigs and rabbits, and especially those of dogs, have the ability, provided they do not suffer any other involvement, to easily overcome any not too virulent infection—direct or indirect within a short time. Such a statement is properly qualified. The virulence of the organism, and, it might be added, the number of organisms determine the question of infection. From the same paper: "The fact that micro-organisms could pass through the liver and other organs in large numbers was first demonstrated, for the 'Rotzbacillus' by Ferraresi and Guanieri; for the staphylococcus, pneumococcus, bacillus Friedlaender cholera vibrio, and bacillus typhosus by Corrado, Nicati, Oemler, Strauss and Chamberland, Oreste, Pernice and Olassi, and Bernabei. Among the earliest investigators on gall-bladder and liver reactions, following experimental procedure, were Charcot and Gombault who ligated the common duct in rabbits and guinea pigs and noted that inflammation of the biliary tract followed, and later, cirrhosis and other changes in the liver. Chambard, Foa and Salvioli, Beloussow, Canalis, Cholmogorow, Lahousse, and Pack carried out similar experiments and obtained similar results . . ." (see 34). Ehret and Stolz ligated the cystic duct twice and cut between the ligatures. They then produced cholecystitis by injecting organisms into the gall bladder. They observed that the organisms first increased in number, then decreased until the gall bladder became sterile. They also noted that foreign bodies introduced into the gall bladder produced stasis which predisposed to infection. These conclusions have been definitely established. Regarding the disappearance of organisms from the gall bladder it is interesting to note the report of Brioni and Kayser (36). They injected three-quarters to 1 cubic centimeter of a saline suspension of pneumococcus into the gall bladders of dogs. After several days they found that the organisms had disappeared from the gall bladder, but were still to be found in the blood. Forster and Kayser (37) were the first to prove that the gall bladder may be a source of infection in chronic typhoid carriers. They reiterated the now established fact that bacillus typhosus injected intravenously can be recovered from the gall bladder. These men also performed the experiments on immunized rabbits and obtained the same results. Doerr (38) now repeated the experiments of Ehret and Stolz, and reported that, following ligation of the

cystic duct, intravenous injection of typhoid bacilli produced no results. After ligation of the common duct, intravenous injection of typhoid produced a cholecystitis. Without ligation, he recovered bacillus dysenteriæ in the gall bladder after intravenous injection. In the light of both previous and subsequent, more careful and exact determinations, Doerr's negative results after ligating the cystic duct may certainly be disregarded. Either his experiments were too few or his observations faulty. Supporters of the descending theory of infection find comfort in Doerr's report. Chiarolanza (39), 3 years later, repeated the experiments of Doerr and recovered typhoid bacilli in the papillary folds of the gall-bladder mucosa following subcutaneous injection of bacillus typhosus.

Following a thorough review of previous literature, Chiari (40) concludes: "Cholecystitis is an hæmatogenous infection to the liver and the bile then infects the gall bladder; bacillus typhosus is regularly found in the bile of typhoid patients (exceptions being rare); the organisms may produce varying degrees of inflammation of the biliary tract; bacillus typhosus may be found inside of gall stones." Chiari's theory of the etiology of cholecystitis was, however, purely a theoretical one. The work of Chiarolanza followed by a report of Koch is much more conclusive. Koch (41) demonstrated, in sections, clumps of bacteria, capillary emboli, in the submucosa and wall of the gall bladder of a man dying of typhoid fever. He concluded that cholecystitis was caused by direct extension, probably meaning through the blood vessels. Meyer, Neilson, and Feusier (42) have recently made an exhaustive study of experimental infections of the gall bladder, particularly with reference to typhoid fever. They consider that the findings of Koch and Chiarolanza of bacterial emboli in the wall of the gall bladder during typhoid to be "exceptionally rare" and concerned with an "exceedingly severe and unique form of typhoid cholecystitis," and they state that an examination of human gall bladders in the cases of death from typhoid shows a capillary embolism only occasionally. These writers also make the important statement that, in order to have bacteria pass through the liver into the bile, it is necessary to have actual inflammatory lesions of the liver; and they add: "the conception of a purely mechanical passage deserves little consideration." It is significant also that both Wyssokowitsch (10) and Blachstein (14) considered liver necrosis as pre-requisite for the infection of the biliary passages in typhoid.

As the gall bladder has now been proved a source of infection in typhoid carriers, numerous investigators endeavored to reach this focus for therapeutic and prophylactic treatment. Conradi (43) produced chronic typhoid carriers in rabbits, and then claimed to have sterilized them with daily doses of chloroform (in milk or oil) by mouth and rectum. Hailer and Rimpau (44) produced experimental cholecystitis by intravenous injection of bacillus typhosus into animals and attempted then to sterilize or rid the animals of the organisms by rectal and oral administration of various drugs. They found methyl iodide and ethyl bromide most efficient. Marxer (45) placed in the gall bladders of dogs, corks soaked in broth cultures of typhoid, producing typhoid carriers. He then endeavored to sterilize the gall bladders by feeding various drugs by mouth. One dog showed positive cultures after four years. Marxer's work was very thorough and his conclusion, that sterilization of the gall bladder by means of drugs administered by mouth is impossible, is accepted today.

Metchnikoff and Besredka (46) now disproved the earlier conclusions of Beumer and Peiper, and Sirotinin, and demonstrated that human typhoid fever could be reproduced in animals (chimpanzees) by feeding them excreta from typhoid patients. Johnston (47) repeated the reproduction of chronic carriers in rabbits by intravenous injection of typhoid organisms. Cholera vibrios were again demonstrated in the gall bladder following intravenous injection by Baroni and Ceaparu (48), Grieg (49), and Cano (50). Then, following a report by Morgan (51), in which he stated that, after intravenous injection, he recovered bacillus typhosus from the gall bladders of only two of the twelve rabbits injected, appeared the work of Gay and Claypole (52). These careful investigators, in an excellent

series of experiments, produced chronic carriers in 76 per cent of the rabbits injected intravenously, and found cultures from the gall bladder more uniformly positive than those from the blood. "Characteristic lesions" of the gall bladder were also found. Hailer and Ungerman (53), and Uhlenhuth and Messerschmidt (54), apparently not accepting the investigations of Ehret and Stolz, reported the production of chronic carriers and chronic inflammation of the gall bladder in rabbits by direct injection of bacillus typhosus into the gall bladder. Hailer and Ungerman stated that the organisms were recovered from the gall bladder regularly up to 31 days after injection and in one case 217 days after injection; and that the chronicity or duration of the infection in the gall bladder was dependent upon the severity of the process. There can be little doubt that these men produced chronic cholecystitis by this method. However, the question of the extent of coincident traumatism of the gall bladder at operation presents itself. Hailer and Wolf (55) also demonstrated bacillus typhosus in the gall bladder following intraperitoneal, as well as intravenous, injection.

A revival of medical treatment of cholecystitis found its inception with the advent of vaccine therapy. Nichols (56), in a contribution from the United States Army laboratories, concluded that intravenous injection of organisms does not produce routine infection of the gall bladder; that vaccine therapy does not cure gall-bladder disease in rabbits; and that gall-bladder studies in rabbits are not suitable for determining immunity in man. Cummins and Cumming (57) also reported that vaccines have no effect on bacillus typhosus in the gall bladder and liver. The logical treatment of clinical cholecystitis was offered by Mayo (58) when he stated that excision of the gall bladder meant removal of the source of infection. Until the recent claims of Lyon (59), medical treatment of gall-bladder disease had been practically discarded in favor of surgery.

The investigations of Rosenow offer a fitting chapter to close the question of experimental cholecystitis by intravenous injection (systemic). He isolated "specific streptococci" from cases of human cholecystitis. These organisms he injected intravenously into rabbits and produced lesions in the gall bladder in 80 per cent of the animals (60). Whether or not this rather high percentage is explained by a specificity remains to be proved. The work of Rosenow is of particular significance, however, because it marks the establishment of hæmatogenous infection as the explanation of the etiology of cholecystitis for a certain percentage of cases. In spite of the numerous previous proofs of blood-stream infection, and of unquestionable negative results following introduction of organisms by mere injection into the gall bladder, Chiari (40), Girode (61) and Létienne (62), with the majority of investigators, accepted and championed the theory of descending infection of the gall bladder from the bile. In 1915 Rosenow (63) insisted that appendicitis, gastric and duodenal ulcer, and cholecystitis were embolic infections from some distant focus by "specific" organisms, especially streptococci, rather than that they were caused by descending, lymphatic, or contiguous infection. In the following year he submitted considerable experimentation (64) and concluded: "The simultaneous occurrence of lesions in the gall-bladder and in the cystic and common ducts following injection of the streptococcus from the gall bladder where these structures were involved, indicates that the lesions may be due to a wide range of affinity of the infecting micro-organisms. The occurrence at the same time of cholecystitis and pancreatitis in the animals injected with bacteria from acute cholecystitis and pancreatitis, and with strains from chronic cholecystitis and from ulcer after animal passage, suggests that the simultaneous presence of the diseases in the same patient is due commonly, in the beginning to hæmatogenous infection, and not so often lymphogenous or local invasion as the findings at operation so often appear to indicate." At about this same time, Nichols (65) reported an extensive investigation which he interpreted as evidence in favor of the descending theory of infection. He stated that micro-organisms enter the bile from the liver if they are present in the blood in

sufficient numbers, that not more than 50 per cent of the injections, however, are followed by positive cultures from the bile, that the organisms are recovered in ½ to 2 minutes after intravenous injection in rabbits; and, finally, he was convinced that experimental typhoid cholecystitis in rabbits was a descending infection in the bile. Schoebl (66) now reported that he recovered cholera vibrios from the gall bladder following intravenous injection by that they produced no lesions in the gall-bladder wall. Lange and Roos (67) injected typhoid organisms directly into the gall-bladder wall of rabbits. They stated that the organisms were recovered in the ear veins in 1 to 2 minutes after injection and disappeared from the circulation after 30 to 60 minutes.

Among the recent contributions to experimental cholecystitis are the report of Mann, from Rochester, and a paper from this laboratory. Mann (68) demonstrated the production of an acute specific chemical cholecystitis by the intravenous injection of Dakin's solution. The fact that a solution of sodium hypochlorite of a certain percentage and in sufficient amount should exert a specific action on the gall bladder in a high percentage of injections (highest in dogs) is striking. The report from this laboratory (33) appeared in January of this year. Experimental cholecystitis was regularly produced by injection of organisms into the lumen of the gall bladder after ligation of the cystic duct and vessels. An associated hepatitis was constantly present. The importance of lymphogenous infection of the gall bladder from the associated hepatitis was demonstrated.

CONCLUSIONS

A study of the literature seems to justify the following conclusions:

1. Intravenous injection of organisms, if in sufficient amount, is always followed by the appearance of these organisms in the bile. The organisms are probably carried to the liver in the blood stream, excreted in the bile, and carried through this medium into the gall bladder. Also, however, organisms are carried at the same time, among other places into the wall of the gall bladder by the blood stream and lymphatics.

2. The intravenous injection of virulent organisms in sufficient amount produces a cholecystitis in a high percentage of cases.

3. The organisms, after intravenous injection, may be demonstrated in the bile ½ to 2 minutes after injection and may be found in the gall bladder after the blood has become sterile.

4. Simple injection of organisms, even in large amounts, into the lumen of a normal gall bladder, does not usually produce a cholecystitis.

5. Injection of virulent organisms into the lumen of a gall bladder in sufficient amounts, after ligation of the cystic duct and vessels, regularly produces a cholecystitis.

6. Although cholecystitis may be due to an hæmatogenous infection, it is not infrequently lymphogenous in origin.

7. Cholecystitis is constantly accompanied by a hepatitis. The character of the lesion in the liver is determined, to a certain extent, by the origin and course of the disease in the gall bladder.

Accepting these conclusions as reasonably established facts, there still remain numerous problems for further consideration. Among those problems the following were considered of sufficient importance to warrant investigation: (1) The passage of organisms into the bile of the gall bladder after injections into the portal and systemic veins, as influenced by ligation of the cystic duct and vessels; (2) the occurrence of organisms within the wall of the gall bladder at a distance from the mucosa soon after portal-vein injections after preventing their descent in the bile by ligation of the cystic duct and vessels; (3) a study of the complications of cholecystitis produced experimentally.

PART II

EXPERIMENTAL CHOLECYSTITIS AND HEPATITIS

Since a considerable part of this investigation was concerned with the relationship between cholecystitis and hepatitis, and since there is a constant relationship between these two lesions, they are considered together. A brief review of the meager early literature on this subject forms the most fitting introduction to the experimentation.

As mentioned in Part I, Charrin and Roger (16) first reported the association of experimental cholecystitis and hepatitis following the introduction of organisms into the common duct. This method of procedure, of course, constituted direct infection of the liver. Following this report very little mention of the association of the two lesions was made in experimental studies.

In clinical medicine, however, we find that the relation was observed early. Riedel (69), in 1888, reported an enlargement of the right lobe of the liver in cholecystitis which is now designated as Riedel's lobe. Naunyn (17) states that Charcot was the first observer to report this relationship. Naunyn himself considered the association frequent in cholelithiasis. Grube and Graff (70) considered that hepatitis was not uncommon in cases of gall stones. Kehr (71) felt that the percentage of liver involvement was about 15 or 20 per cent in cholecystitis. Quincke (72) considers enlargement of the liver in cholelithiasis the rule, while Rolleston (73) does not regard the association as a frequent one.

It remained for Graham (74), however, to show that hepatitis is a constant accompaniment of cholecystitis, and subsequent work under his direction and supervision fully established this fact (33). A report of this investigation demonstrated that (1) the experimental cholecystitis was constantly accompanied by a hepatitis; (2) this hepatitis consisted, as previously pointed out by Graham, of a periportal or interlobular infiltration of leucocytes; (3) the same organism was isolated from both the liver and gall bladder; (4) infections of the gall bladder by the lymphatic route are easily produced. Attention is again directed to the excellent description of the lymphatics of the gall bladder which has been written by Sudler (75) and of the liver which has been written by Mall (76).

Investigation was now begun on the problem of recovery of organisms in the gall-bladder bile following intravenous (systemic) and portal vein injections, with and without ligation of the cystic duct and vessels; and, also, on the production of experimental cholecystitis.

EXPERIMENTS

Series A. Portal vein injections and cultures of bile. Normal rabbits of medium size were used. In 20 animals the following routine was carried out: anæsthetization; sterilization of the skin, and median line laparotomy with exposure of the portal vein. Three cubic centimeters of 24-hour broth culture of staphylococcus albus was injected into the portal vein. Three minutes after injection 1 cubic centimeter of bile was taken from the gall bladder (through the seared wall) and plated on agar media (plain and blood). Immediately thereafter 1 cubic centimeter of the heart's blood was taken (through a seared surface) and plated on agar media.

In 15 of the 20 rabbits, positive cultures of staphylococcus albus were demonstrated in the bile from the gall bladder. In all 20 the heart's blood was positive for the same organism.

Series B. Same as above except for previous ligation of cystic duct and vessels. In a second set of 20 rabbits, the operative routine of Series A was repeated and, in addition, the cystic duct and vessels were ligated. The portal vein was then immediately injected with 3 cubic centimeters of staphylococcus albus as before. Three minutes later cultures of the bile and of the heart's blood were obtained as above. All 20 of the rabbits showed positive cultures of staphylococcus albus in the heart's blood, while the gall-bladder bile was negative in every instance.

Series C. Portal vein injections after ligation of cystic duct and vessels 10 days previously. Ten rabbits were used. The procedure consisted of two stages. At the first stage, the animals were prepared in the usual way and the cystic duct and vessels ligated. The abdomen was now closed and the animal returned to the observation room. Ten days later the abdomen was again opened (with the same aseptic precautions) and the portal vein was injected with 3 cubic centimeters of 24-hour broth culture of staphylococcus albus. After 3 minutes the gall bladder contents and the heart's blood were collected as above. The organisms were recovered in the gall-bladder contents in 6 of the animals and in the heart's blood in all

Of the four negative gall bladders, 2 were gangrenous, and one small, white, and contracted. They were not studied in section.

Series D. Injections into ear veins. Five normal rabbits were used. Three cubic centimeters of 24-hour broth culture of bacillus coli were injected into the ear vein of each. The heart's blood and gall-bladder bile were collected and plated aseptically 3 minutes after injection. The heart's blood was found positive in 4 animals; the gall-bladder bile in 3.

Series E. Injections of virulent organisms into ear veins. Two and one-half cubic centimeters of virulent culture of bacillus coli were injected into the ear veins of each of 5 rabbits. These animals were killed 7, 8, 8, 9, and 11 days respectively after injection. The heart's blood was sterile in all 5 animals. In 4 the gall-bladder bile was found to contain bacillus coli. Positive lesions in the gall bladder were found in 3 rabbits. The cholecystitis was acute and involved the entire wall. The walls were œdematous, hæmorrhagic, and showed recent adhesions to the liver.

Series F. Production of cholecystitis by portal vein injections. Seven normal dogs were used, and the following routine was carried out: After anæsthetization and preparation of the skin, a median-line incision was made. The portal vein was exposed at its origin. Four to 6 cubic centimeters (depending upon size of animal) of virulent staphylococcus aureus (24-hour broth culture) were injected into the portal vein, and the abdomen closed. These animals were observed daily and were killed at various intervals of from 2 to 6 days and then autopsied. In 3 animals, no apparent lesion followed the first injection, and a second injection of hæmolytic streptococcus (2 cubic centimeters) was given. This produced a definite cholecystitis. A description of the lesions found at autopsy is given in the protocols.

PROTOCOLS OF SERIES F

Dog 4. Five cubic centimeters staphylococcus aureus and second injection 2 cubic centimeters hæmolytic streptococcus. Killed 2 days after second injection.

Autopsy. Liver: no gross lesions. Microscopic—acute hepatitis, general infiltration red blood cells. Gall bladder: wall greyish pink, adhesions to liver. Microscopic—severe acute inflammation throughout entire wall: marked infiltration of leucocytes. Mucosa well preserved.

Dog 5. Five cubic centimeters staphylococcus aureus and (second injection) 3 cubic centimeters hæmolytic streptococcus. Killed 3 days after second injection.

Autopsy. Liver: slightly œdematous and dark in color. Microscopic—general acute hepatitis with infiltration: most marked in periportal tissues. Gall bladder: no gross lesions. Microscopic—acute inflammation throughout wall: mucosa fairly well preserved (Fig. 1). Common duct: Microscopic—acute inflammation with infiltration of walls with leucocytes: mucosa well preserved.

Dog 2. Four cubic centimeters staphylococcus aureus and (second injection) 6 cubic centimeters staphylococcus aureus. Killed 3 days after second injection.

Autopsy. Liver: œdematous, dark in color. Microscopic—hepatitis marked: infiltration of polymorphonuclears, marked cell vacuolization. Gall bladder: pale in color—adhesions to liver. Microscopic—marked acute inflammation: mucosa preserved. (Staphylococcus aureus demonstrated in walls.) (Fig. 2.)

Dog 6. Six cubic centimeters staphylococcus aureus. Killed 3 days after injection.

Autopsy. Liver: No marked gross changes. Microscopic—acute hepatitis, general infiltration of polymorphonuclears especially marked in interlobular sheaths and general hæmorrhage into parenchyma (Fig. 3). Gall bladder: gross, red, hæmorrhagic, many adhesions. Microscopic—marked acute inflammation throughout wall: mucosa well preserved.

Dog 7. Five cubic centimeters staphylococcus aureus. Killed 4 days after injection.

Autopsy. Liver: somewhat œdematous, friable; dark color; abscesses (Fig. 4). Microscopic—generalized acute hepatitis; many polymorphonuclears. Gall bladder: wall greyish pink with numerous adhesions (Figs. 5 and 6). Microscopic—acute inflammation; slight involvement of mucosa. Common duct: acute inflammation throughout wall; marked congestion of submucosa and ulceration of mucosa.

Dog 3. Five cubic centimeters staphylococcus aureus and (second injection) 2 cubic centimeters streptococcus. Killed 5 days after second injection.

Autopsy. Liver: several abscesses, scattered. Microscopic—general hepatitis; many leucocytes especially in the periportal sheaths and immediately under the capsule of the liver (Fig. 7). Gall bladder: adhesions to liver, quite firm; wall grey. Microscopic—acute inflammation involving entire wall with preservation of mucosa. Common duct: mucosa ulcerated, submucosa and muscular coat congested and infiltrated with leucocytes (Fig. 8).

Dog 1. Five cubic centimeters staphylococcus aureus. Killed 6 days after injection.

Autopsy. Liver: Somewhat swollen, greyish blue color, edge rounded (Fig. 9). Microscopic—extensive hepatitis; marked infiltration of polymorphonu-

clears, most marked in interlobular sheaths. Gall bladder: bound to liver with adhesions. Microscopic —marked inflammation with polymorphs throughout wall (Fig. 10); mucosa markedly involved. Common duct: acute inflammation, marked. The entire wall was congested and infiltrated with polymorphonuclears and some red blood cells.

The pancreas was examined in all seven dogs. The findings are reported in Part IV.

Three dogs required a second injection of organisms to produce a definite cholecystitis. The livers in this series showed a strikingly uniform picture, i.e., a general hepatitis, leucocytic infiltration, general but more marked around the central veins. The gall bladders showed various degrees of inflammation with involvement of the entire wall except the mucosa. The mucosa was markedly involved in only the later stages of the process.

Series G. The liver and gall bladder studied in experimental general peritonitis. In an effort to interpret the pathology of the liver reactions, a generalized peritonitis was produced in four dogs by traumatization of intestines and injection of fæces, intraperitoneally. These animals were killed after various intervals, from 24 to 96 hours. Sections of the gall bladder and liver were studied. A cholecystitis was found in two dogs. The mucosa of the gall bladder was not markedly involved. The liver showed various reactions. As a rule there was a general involvement of the entire organ. In the gross it was dark, œdematous, and friable, and, in a few cases, abscesses were found. In section the pictures were variable. There was usually a general hepatitis and pericholangeitis, in some parts a central necrosis, and in others hæmorrhage into the parenchyma of the organ. The whole reaction was similar to that observed following portal vein injection. This picture differs essentially from that produced when the liver is involved secondarily from the gall bladder.

Series H. Demonstration of organisms in the wall of the gall bladder after portal vein injection. In this series six rabbits were used. The cystic duct and vessels were ligated. Two cubic centimeters of hæmolytic streptococcus was then injected into the portal vein. The rabbits were killed after 1, 2, 12, 24, 24, and 48 hours respectively. Sections were stained for bacteria in addition to the hæmatoxylin-eosin stain. Blocks were cut of the gall bladder with the adjacent liver in the normal relationship.

In all of these sections streptococci were demonstrated in the liver. In the one and two hour sections, the organisms were found in the region of the veins and between the cells of the parenchyma. In the latter sections organisms could be demonstrated within the cells and surrounded by phagocytes. In sections from four rabbits streptococci were demonstrated within the gall-bladder wall.

Part III

Appendicitis and Peptic Ulcer as Associated with Cholecystitis

The history of appendicitis and gastric and duodenal ulcer in their relation to cholecystitis is almost entirely a clinical one. Many earlier clinicians and a few experimental investigators made occasional comment on the relationship, but few studied the problem or reported experimentation.

Adrian (77), in 1901, was among the first to conclude that appendicitis was a blood infection. Very little experimental work was done at this time. A number of clinical reports, however, show interesting statistics. In the Mt. Sinai Hospital Report of 1904 (78) there were 7 cases of ulcer coming to operation in which 3 showed foci of infection within the area drained by the portal vein. Ochsner, who was among the first to observe the relation between appendicitis and gall-bladder disease, reported in 1906 (79) 4 cases of pyloric ulcer, 2 of which were associated with biliary tract infection, 2 with appendicitis (1 case had both lesions), and 13 cases of biliary-tract infection of which 4 had pyloric ulcer and 7 appendicitis. In the following year, Deaver (80) reviewed 66 cases of ulcer, 15 of which gave a history of preceding dysentery, typhoid, appendicitis, or biliary-tract infection. Kretz (81) observed a number of cases of appendicitis following angina and stated that this was proof of the hæmatogenous origin. In the later paper (82) he concludes that, considering the results of these new experiments (about 60 cases) he must regard the hæmatogenous origin of appendicitis as typical. Aschoff (83), in the same year, was

convinced that angina and appendicitis were similar infections of bacterial origin and that tonsillitis may cause appendicitis. Cannon (84) reached the same conclusions.

In 1908 Moynihan (85) reported 205 cases of ulcer, 16 of these required biliary-tract surgery. The appendix was not examined. Gibbon and Stewart (86) reported 22 cases of ulcer with perforation, which came to operation. In 6 appendicitis was diagnosed before operation and chronic inflammation of that organ found on removal; in the remaining cases the appendix was not examined. MacCarthy and McGrath (87) reported a very thorough pathological study at operation and at autopsy. In 52 ulcers, 26.9 per cent were associated with chronic appendicitis. One hundred and seventy-five cases of biliary-tract infection showed almost 50 per cent associated with chronic infection of the appendix. Of 2000 chronic appendices, 8.7 per cent had biliary-tract infection.

From this time on the coincidence of these lesions was given increasing attention. The Augustana Hospital Report for 1910–11 (88) contained the following statistics: 514 chronic appendices of which 45 had biliary-tract infection; 79 ulcers of which 35 had chronic appendices, 14 had biliary infections, and 7 had all three lesions. Of 141 cases of biliary infections, 5 had ulcer, 68 had chronic appendices. Filcher (89) reported a very excellent study of the relation between appendicitis and biliary and gastric lesions. He studied 100 cases of chronic gastritis (proved by sections) and found that 36 had appendicitis; 12 had appendicitis and biliary-tract infection; 60 had biliary-tract infection; 16 had biliary and pancreatic infection. Mitchell (90) reported 48 pyloric ulcers, 19 of which were associated with chronic appendicitis.

In 1912 Aschoff (91) advanced the view that appendicitis was due to a specific streptococcus and began as an embolic infection. Rosenow (60) held the same view and produced appendicitis in animals by injecting "specific" streptococci obtained from cases of human appendicitis. He claimed to have obtained positive lesions in 68 per cent of his injections. Ghon and Namba (92) also believed appendicitis an hæmatogenous infection caused by a specific organism. Heyde (93), in a most complete review of appendicitis and an exhaustive investigation, concluded that several organisms were responsible for the lesion. Heyde's experimental investigations were thoroughly detailed, yet no mention is made of associated lesions. Moynihan (94) in his monograph on "Duodenal Ulcer," reported some interesting data. In 62 cases of ulcer, 6 required biliary drainage. 25 had chronic appendices; 2 had appendicitis and biliary drainage and ulcer. A study of the appendix in 14 consecutive cases of pyloric ulcer showed 12 chronic appendices, the remaining 2 cases were too ill to permit further study.

Moynihan believes that the appendix should be removed in 90 per cent of cases of ulcer and biliary disease. In 1910–11, of 322 ulcers operated upon, Moynihan discovered 111 chronic appendices requiring appendectomy.

La Roque (95) gave the following causes for pyloric ulcer: central necrosis of an area of inflammation; necrosis caused by bacterial infection; source of bacteria, some focus of inflammation in the area drained by the portal vein. He added: "Pyloritis, pyloric ulcer, bile-tract infection, pancreatitis, and perhaps, cirrhosis of the liver, are late results of infection primarily located, most commonly, in the appendix though in many cases in some other region drained by the portal vein; and these lesions frequently exist together in the same patient at the same time or may follow each other in rapid or slow succession."

Rosenow (96), in 1914, submitted further experimental investigation. He produced appendicitis in animals by the intravenous injection of streptococci made virulent by animal passage. In 1915 (97) he produced appendicitis in 41 of the 59 rabbits injected. He used for these injections, the organisms recovered from cases of human appendicitis (recovered at operation). Deaver (98) summed up what is probably the modern practice in surgery when he stated that in case of gall-bladder infection, whether there are calculi or not, operation should include removal

of the appendix and examination of other abdominal viscera for associated disease.

The appended experimentation on appendicitis is very meager. No work was done on ulcer. Only three animals were used for experimentation.

In two rabbits the appendicular vein was injected with 3 cubic centimeters of hæmolytic streptococci. The animals were killed (A. V. I_1) and (A. V. I_2) 2 hours after injection. In a third rabbit 4 cubic centimeters of hæmolytic streptococcus (24-hour broth culture in all 3 cases) was injected into the appendix wall. This animal was killed 4 hours after injection (A. I.).

In all three cases sections were made of the liver, gall bladder and the liver (with their normal attachment), pancreas, and common duct. In all three of these animals the injected organisms were demonstrated in the liver by culture and in section. In A. V. I_1, A. V. I_2, and in A. I., the organisms were demonstrated within the gall-bladder wall, liver, and pancreas in sections (Figs. 11, 12, 13, and 14). (For common duct and pancreas see Part IV.)

Part IV

Cholecystitis and Pancreatitis

The history of the relation between infections of the pancreas and the biliary system is a most interesting one. In 1896, Nicholas Senn (99), one of the pioneers in the surgery of the pancreas, made the following observations: "Peripancreatic suppuration commences, in most instances, in the adjacent lymphatics. . . . The presence of pus within the pancreas or in its immediate vicinity is not indicated by any characteristic or positive symptoms. The symptoms always point to the stomach or liver as the seat of the disease. . . . In several instances the inflammatory process in the pancreas extended to the bile duct, or caused stenosis of the duct by compression, conditions which are usually followed by biliary retention, a symptom which has been usually interpreted as evidence of primary disease of the liver or bile ducts."

The important work of Opie (100) is perhaps the greatest contribution to our modern conceptions of the pancreas and its diseases. Most of Opie's observations were confined to cholelithiasis and were considered from the standpoint of obstruction. Regarding "the association of acute pancreatitis and cholelithiasis," he advances the following considerations: "The etiology of hæmorrhagic necrosis of the pancreas has remained obscure until a series of cases recently studied has demonstrated a relationship between the lesion and cholelithiasis. Since the common bile duct and the duct of Wirsung unite to form the diverticulum of Vater before they reach the duodenum, changes in the one duct may be transmitted to the other, thus producing secondary lesions of the liver or pancreas. The association of pancreatic disease with alterations of the bile passages has been noted by Koerte, Oser, Lancereaux, and other writers. . . . The cases which have been cited suggest no process nor mechanism by which a lesion of the pancreas results from the presence of a calculus in the common bile duct near its duodenal orifice. The autopsy upon a second case of hæmorrhagic necrosis of the pancreas studied in the partial light of that already described (Case I) has demonstrated a mechanism by which a small biliary calculus produces a destructive lesion of the pancreas and at the same time has brought our knowledge of the lesion into correlation with facts demonstrated by experimental means. The preceding autopsy has disclosed a condition which explains, I believe, the pathogenesis of cases of so-called acute hæmorrhagic and gangrenous pancreatitis which are associated with gall stones. The diverticulum of Vater was 10 millimeters in length. Lodged at its apex, blocking the duodenal orifice, was a small calculus only 3 millimeters in diameter, but too large to pass the narrow opening. Though it occluded the duodenal orifice of the diverticulum, it was so small that the orifices of the common bile duct and of the pancreatic duct were obstructed. The two ducts were, therefore, converted into a continuous closed channel from which it was not possible for either bile or pancreatic juice to escape. . . . The etiology of interstitial inflammation is often obscure. Chronic pancreatitis is not infrequently secondary to changes

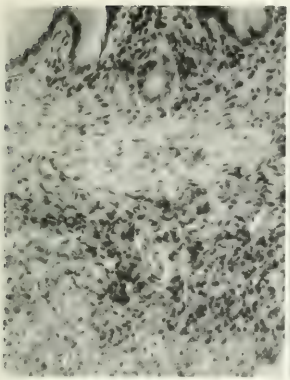

Fig. 1.

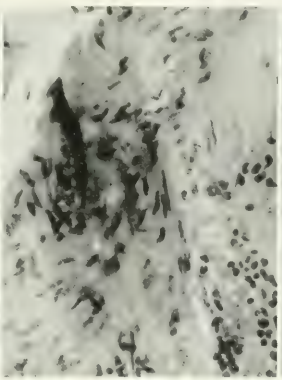

Fig. 2.

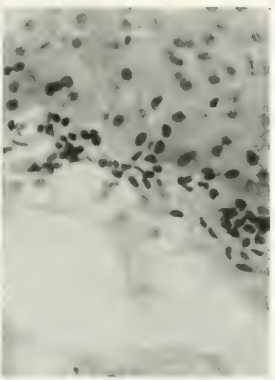

Fig. 3.

Fig. 1. (Dog 4.) Gall-bladder wall showing acute inflammation.

Fig. 2. (Dog 5.) Gall-bladder wall near liver.

Fig. 3. (Dog 6.) Liver.

in the intestine, bile passages, and the liver. As with other glands, there is more than one path by which inflammatory irritants may reach the organ; by way of the duct, from the blood vessels, and possibly from the lymphatic vessels. . . . "

Nordmenn (101) stated that, in the production of acute hæmorrhagic pancreatitis by experimental means, two factors are necessary: first, complete stasis of pancreatic juice in the ducts, and secondly, multiplication of pancreatic juice in the stagnant secretion. Injection of the organisms without occlusion of the ducts produced no results. Heiberg (102), in his book, adds very little to Opie's observations. Regarding pancreatic inflammation he says that the establishment of an inflammation in the pancreas itself becomes possible when a gall stone is lodged for a longer or shorter time, especially when an infectious disease of the biliary tract, which is of itself a predisposing factor, precedes. Reidel laid emphasis upon his observation that enlargement of the pancreas could take place with a subsequent reduction in size. All 3 of his patients had gall stones. Reidel brought up the question of the danger which would have followed attempted removal of the stones in the belief that one was dealing with an inoperable tumor. However, why should one lay the cause of the jaundice to the pancreas when there are gall stones present at the same time? In the year 1903 Reidel considered the fact established that the hard tumors (enlargements) found in chronic pancreatitis, could readily return to their original size when the gall stones were removed.

It seems quite strange that the lymphatic connections between the biliary tract and the pancreas, with all of the possibilities for transmission of infection, should not have received greater attention. Deaver (103) who repeated Senn's observations about 27 years later stated: "The lymphatics, however, in my opinion, play a conspicuous rôle in conveying infection of the pancreas." Five years previous to this statement Maugeret (104), in his thesis, presented a most excellent contribution to our knowledge of the lymphatics of the pancreas, and pointed out the possibilities of infection by this route. His review of the history is good, his experimentation careful, and his conclusions are worthy of special consideration. Maugeret's conclusions are presented as translated:

1. Pancreatitis co-existing with cholelithiasis is not an affection independent of the latter, nor is it a contemporary or parallel affection, due to the same initial cause, and

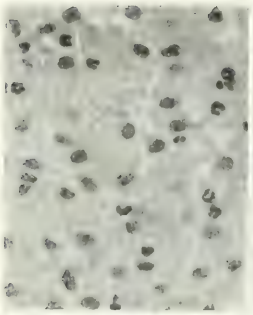

Fig. 4.

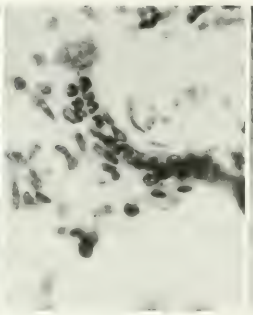

Fig. 5.

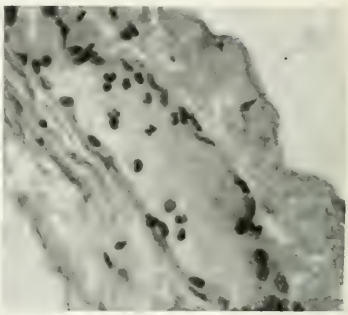

Fig. 6.

Fig. 4. (Dog 7.) Polymorphonuclears scattered throughout the liver lobule.

Fig. 5. (Dog 7.) Polymorphonuclear leucocytes in the deeper layers of the gall-bladder wall.

Fig. 6. (Dog 7.) Acute inflammation of the gall-bladder wall with numerous adhesions and slight involvement of the mucosa.

then simply maintained by it. It is a real complication, as shown by clinical observation and therapeutics.

2. Its point of departure is, neither directly nor indirectly, an intestinal infection, which has never been clearly demonstrated.

3. The infection does not reach the pancreas by the canalicular route; this propagation which neither the topography of the lesions nor their histologic localization can prove, has but very little chance of being produced, with the strong bactericidal properties of the pancreatic juice and the normal physiologic body of an excretory system (which keeps from stagnation by the absence of a diverticular reservoir).

4. Neither is it by simple contiguity that the infection reaches the pancreas; this method of spreading is liable to occur solely in conditions which are found after very rare cases.

5. In all cases of lithiasis that may occur, the pancreatitis seems to come from one cause, always the same in all these cases.

6. This sole cause of pancreatitis in all cases of lithiasis is the only constant condition which is common to all these cases, that is, the infection of the biliary vesicula; this is proved even by the treatment of this pancreatitis which consists essentially in the disinfection or suppression of the vesicula.

7. The vesicular infection spreads to the pancreas through the efferent lymphatics of the vesicule, ending in the important ganglionic group which, both periglandular and juxtaglandular, occupies the region around the head of the pancreas. This group also receives the efferent routes from the pancreas itself, and largely anastomoses between them and its surface; this surface is therefore situated in a veritable lymphatic crossroad which could easily be invaded through its periphery, since the infection tends to cross the ganglionic barrier.

8. It seems, therefore, that of the four possible modes of pancreatic infection—the blood route, canalicular route, contiguity, and the lymphatic route—the last mentioned is not only possible but frequent.

Regarding the anatomy of the biliary and pancreatic lymphatics Poirier (105) gives the following: "The lymphatics of the extrahepatic passages arise from two networks, one mucous, and the other muscular. The collecting trunks which arise from these networks end in the glandular satellite chain which is a satellite of the cystic and common bile duct. Intimate relations exist between the lymphatics of the terminal segment of the common bile duct and the lymphatics of the duodenum and the head of the pancreas."

Bartels (106) refers to Sappey as stating that the lymphatics of the gall bladder drain into the superior pancreatic lymphatics. It is of historical note that Bartels gives Olaus

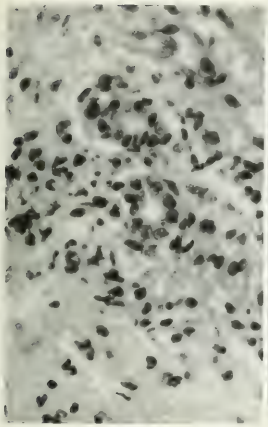

Fig. 7.

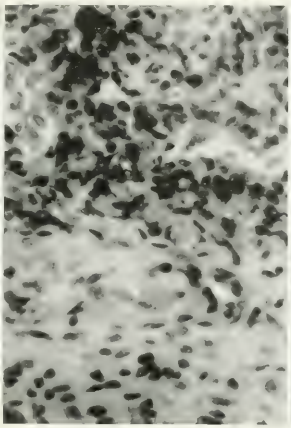

Fig. 8.

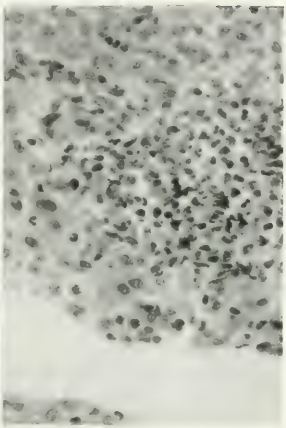

Fig. 9.

Fig. 7. (Dog 3.) Acute hepatitis.
Fig. 8. (Dog 3.) Wall of common duct showing acute inflammation.

Fig. 9. (Dog 1.) Liver: marked periportal infiltration with polymorphonuclear leucocytes.

Rudbeck (1659) credit for the first description of the lymphatic system as a separate vascular system. J. Vesling (107) gave a description, probably the first, of the lymphatics of the pancreas, in 1647. Free translation of his work conveys the following: "The chyle is taken up and delivered to the liver, not through any veins, but descending from the portal, now confirmatory, now distributory, to the veins. Asellius called these lacteals, so that the investigator should remember more readily, because the color of the liquid admitted was white. Moreover, the vessels are long and twisted, starting from a thin membrane upward from the pancreas, around the trunk of the descending vena porta from the liver downward, and from the intestines composed of very minute propagative vessels. The liquid is taken up from the intestine and the vessels are furnished with closing valves. These connections have to do with the spleen as well as the pancreas. The origin of the veins of these lacteals is not derived from any other source than from the pancreas. For nature extended the arteries and the red veins, by which they are recognized both in their composition and in their function, not from a narrow, forked-shaped base but from the more ample foundation of the trunks. In the same way the foundation of the lacteals is similar to the amplitude about the pancreas. The branches extend, indeed, to the liver and to the intestines. To collect all these into a common trunk on account of the marked width of the pancreas was not pleasing to the divine conductor; who held it sufficient that in whatever manner connection should be made between the nerves and the organs of the senses, they must come forth from some common spring but at distinct intervals."

Bartels in a later work (108) on the lymphatics of the pancreas said that, "of especial interest was a lymph vessel in the hepatoduodenal ligament which also showed the blue color (injection fluid); this is connected with a part of the pancreas. From this lymphatic there is a blue stripe leading up the portal vein toward the liver, which cannot be followed farther." Arnstein (109) in 1912 reviewed the works of Bartels, Maugeret, and Arnesperger and emphasized the importance of the lymphatic origin of pancreatitis secondary to biliary infection. Klippel (110), as early as 1897, made the observation that tuber-

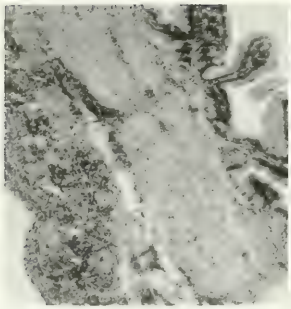

Fig. 15.

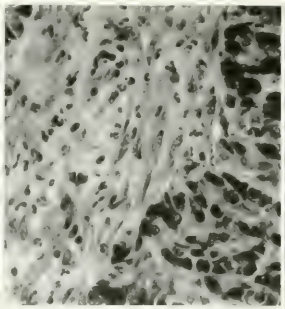

Fig. 16.

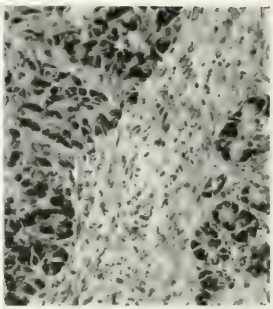

Fig. 10. Dog 1. Extensive inflammation of gall bladder wall; mucosa relatively unaffected.

Fig. 15. Dog. Acute interstitial pancreatitis.
Fig. 16. (Dog.) Same as Figure 15, another animal.

culous pancreatitis was a secondary infection propagated by "*le système lymphatique.*"

A study of the pancreas of the seven dogs reported in Part II, Series F, revealed changes of note. Four of the seven organs showed a definite involvement. In two there was a marked acute inflammation with infiltration of leucocytes and beginning destruction of gland parenchyma. The lesions were definitely interstitial pancreatitis. One showed a moderate peripancreatitis and one a mild degree of pancreatitis (Fig. 16). In the experiments quoted in Part III, i.e., appendix injection, sections were made of the pancreas. In section A. V. I.$_1$, streptococci were demonstrated in the common duct immediately surrounding a lymphatic vessel passing in intimate contact with the pancreas. In experiment A. I. a section of the pancreas showed staphylococci in the peripancreatic tissue (Fig. 17). There seems to be little doubt that organisms once introduced into the appendicular or biliary lymphatics easily gain access to the pancreas. Obstruction or stasis is not absolutely essential to production of acute pancreatitis.

Fig. 12.

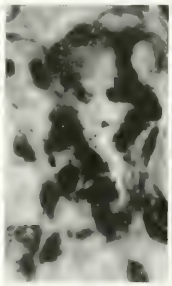

Fig. 13.

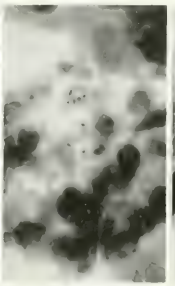

Fig. 14.

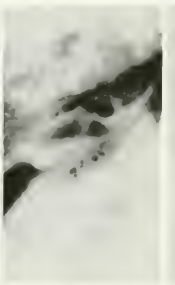

Fig. 17.

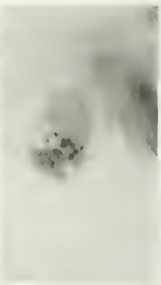

Fig. 11. Rabbit. Experimental hepatitis; organisms in liver near attachment to gall bladder. Portal vein injection streptococci.

Fig. 12. (Rabbit.) Same as Figure 11, another animal. Twelve hours after injection.

Fig. 13. (Rabbit.) Experimental cholecystitis; organisms in gall-bladder wall 2 hours after portal vein injection with ligation of cystic duct and vessels.

Fig. 14. (Rabbit.) Same as Figure 13, another animal, 12 hours after injection.

Fig. 17. (Rabbit.) Organisms in pancreas 12 hours after injection of portal vein.

Part V

A study of 130 cases of human gall-bladder disease

Throughout the prosecution of this investigation the co-existence of the several associated lesions with cholecystitis has stimulated a further and more exhaustive consideration of analogous conditions in the human. This study was made on the last 130 (unselected) cases of gall-bladder disease admitted to the Surgical Service of Barnes Hospital. The object in reviewing these histories and the sections was to study in detail the pathological findings in gall-bladder disease and its complications. The earlier histories were considered mostly for the sake of comparison, the findings recorded probably having been quoted on account of their outstanding features since no especial thought was given to the complications. These early reports then are of distinct value. Thirty-three cases were critically analyzed and studied in greater detail, which included a study of the gall-bladder wall, and of sections of the liver removed at operation. In seven other cases which came to autopsy the liver was studied microscopically.

In addition to the pathological studies, these cases show other interesting features. Of the 130 cases, 80 were females, and only 17 of these women gave no history of pregnancy. Cholelithiasis (with or without complications) as a pre-operative diagnosis was made 92 times and stones were found in 79 cases; cholecystitis (exclusive of stones) was diagnosed in 30 instances; the remaining 8 cases were diagnosed variously as carcinoma of the pancreas, etc.; carcinoma of the common duct; appendicitis; and duodenal ulcer. Twenty gall bladders were reported "not markedly abnormal" on gross appearance. All, however, showed pathological changes on section. The liver was found involved in 82 cases, no mention of the liver made (or "incomplete examination," or "marked obesity," or "marked pain prohibiting physical examination") in 38 cases, while in the remaining 10 cases the organ was reported "normal," "not enlarged," or "no marked changes." Small sections of the liver were taken at operation from 26 cases. These sections were studied in great detail. One hundred and thirty gall bladders were carefully studied and will be considered below.

In 82 cases of liver involvement, 69 were "enlarged," or "œdematous," 5 showed "adhesions" alone, and 8 were atrophic or scarred. Of these cases 7 came to autopsy where further study was possible. In this connection, it is of interest to note that of the 7 cases autopsied, no mention was made of the liver on physical examination or at operation in 3. In these 3 cases the pathologists reported as follows: in one "polymorphonuclear infiltration extending into the liver from the gall bladder; also vacuolization of the liver cells"; in another, "marked infiltration of round cells and polymorphonuclears about the portal vein and bile ducts"; and in a third, "infiltration about the portal vessels and bile ducts with polymorphonuclears and mononuclears, beginning fatty degeneration." Examination of these sections confirmed the reports. Changes were also found and studied in the remaining 4 autopsied livers.

The chief interest in a study of these cases was the frequency and the nature of hepatic involvement. Definite hepatic pathology was noted in 63.77 per cent of the cases. This percentage is far too low, especially in view of the fact that a number of livers reported normal were later proved to be involved and about 30 per cent of the cases contained no mention of the liver findings. In a complete study of 33 cases the liver was found involved in every case. This involvement consisted, in gross, in findings which varied from slight œdema and rounded edge to enlargement well down into the abdomen. Microscopically these livers showed a constant, uniform picture. In the acute cases there was a pericholangeitis, at times a general hepatitis, with infiltration of polymorphonuclear leucocytes into the interlobular spaces especially around the bile ducts. These inflammatory changes have been found to be more marked in the gall-bladder region. In the chronic cases there was observed an increase in connective-tissue elements in the periportal or interlobular spaces with a mild or moderate

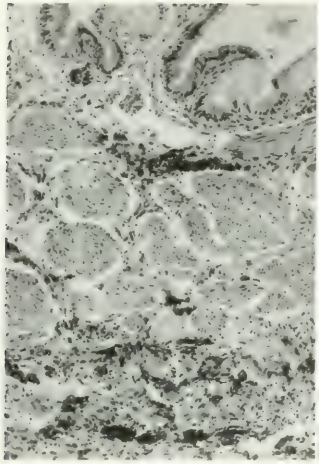

Fig. 18.

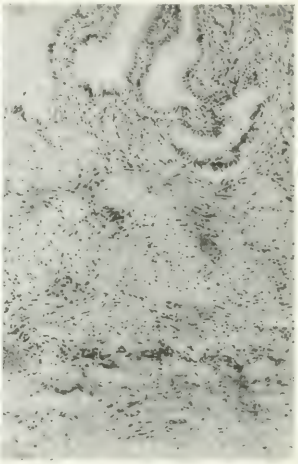

Fig. 19.

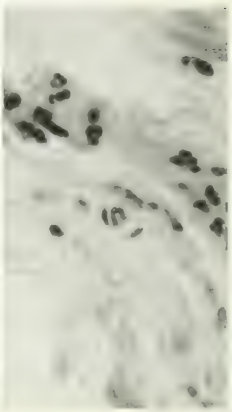

Fig. 20

Fig. 18. Human gall bladder; wall extensively infiltrated with leucocytes, mucosa relatively intact.

Fig. 19. Human gall bladder; mucosa relatively intact; infiltration of leucocytes in the outer layers of the wall.

Fig. 20. Human gall bladder; leucocytic infiltration of wall; apparently thrombosed lymph vessel near serosa of wall.

infiltration of mononuclear leucocytes. The gall bladders in this series in great majority showed an inflammation of the entire wall with many times a fair preservation of the mucosa (Figs. 18 and 19). In previous reports (33 and 73) these findings have been noted and reported. Sections of the liver following portal vein injection (see Part II) show hepatic lesions which are considered as characteristic of primary infection of the liver followed by a cholecystitis. This pathological picture is more typical of a hæmatogenous one. (In this regard it is believed that the frequency of cholecystitis in women who have borne children may be explained by infection of the liver [since all of the abdominal viscera are more congested and exposed to infection], following which there is a localization of organisms in the gall-bladder wall. Here the organisms remain quiescent until suitable conditions afford opportunity for their development with the subsequent results.)

Regarding infections of the liver as to primary or secondary involvement, there will always be difficulty in explanation. It is easily conceivable that micro-organisms could set up an inflammation in the liver which would be transmitted to the gall bladder. In this organ the bacteria might become lodged and remain dormant while the hepatitis or primary infection subsided. The liver, as is well known, possesses remarkable bactericidal properties. Cholecystitis probably begins in most instances as an infection within the wall of the gall bladder, and doubtless, in many cases, it is secondary to a hepatitis. This infection may be acquired from the appendix, intestines, etc., or it may be secondary to any infectious focus within the body. The infection may then spread easily by the lymph stream to the wall of the gall bladder (Fig. 20). The complications then follow.

Mallory (111 and 112) describes the liver changes in typhoid fever as "one produced in the lymphoid tissue, which occurs in the so-called portal spaces, and which shows changes identical with those in the Peyer's patches;

the other occurring anywhere within the lobule, and involving the destruction of a group of liver cells." Given, therefore, an involvement of the lymphatics of the liver, a secondary involvement of the gall bladder through the lymphatics is easy of conception. The frequency of cholecystitis with and following typhoid fever is thus readily explained.

Part VI

DISCUSSION

From a review of the literature presented here and also from the experiments done in this laboratory, it is evident that cholecystitis and biliary-tract infections may be produced in a variety of ways. Any experimental method by which virulent organisms are carried through the blood stream directly to the gall bladder is followed in the majority of cases by the development of a cholecystitis. Experiments reported in this article and also some previously reported in conjunction with Priest and Graham (33 and 113) serve to emphasize the importance of the lymphatic route in the pathogenesis not only of cholecystitis, but also of its complications, such as pancreatitis, hepatitis, and inflammation of the common duct. Although the possibility of the lymphatic rôle in the pathogenesis of pancreatitis secondary to cholecystitis has been mentioned before, particularly by Maugeret, it is thought that the experiments carried out in this laboratory are the first which have brought direct evidence indicating that cholecystitis is not infrequently lymphogenous in origin. The evidence, both experimental and clinical, seems to suggest strongly that perhaps in the majority of cases cholecystitis is produced secondarily to a hepatitis by lymphatic extension. This conclusion is based on a number of facts: (1) The well-recognized association of lesions of the portal system (appendicitis, duodenal ulcer, etc.) with cholecystitis suggests that organisms are carried through the portal vein to the liver from these lesions and that a hepatitis occurs before the cholecystitis because there is no direct pathway between the appendix, for example, and the gall bladder. (2) By direct injection of organisms into a radicle of the portal vein, as, for example, the appendix vein, it is possible to produce cholecystitis. (3) There is no direct route by the blood stream by which organisms can be carried to the gall bladder from the liver, since the cystic artery and the other smaller arteries which are the only source of arterial blood to the gall bladder are branches of the hepatic. Organisms, therefore, to gain access to the gall bladder from the liver via the blood stream, would have to travel the circuit of the whole systemic circulation from the liver back through the cœliac axis and the hepatic artery. This would seem an unlikely occurrence in the majority of instances. Only two possibilities, therefore, remain. One is that the infection spreads from the liver to the gall bladder through the abundant lymphatic connections and the other is that organisms pass down in the bile into the gall bladder. There are several reasons, however, for thinking that, contrary to a common belief, descending infection of the gall bladder from the bile is comparatively rare. One of these reasons is that it is almost impossible to produce experimentally a cholecystitis by merely putting bacteria into the lumen of the gall bladder unless at the same time one injures the wall severely either by direct means or by interference with the circulation, or unless the cystic duct is obstructed so that the gall bladder cannot empty itself. Another reason is that, also contrary to the usual belief, in human cases the mucosa is usually less involved, as shown microscopically, than is the rest of the wall. This could hardly be expected to be the case if cholecystitis commonly occurred as the result of contact infection of the mucosa of the gall bladder from bacteria present in the bile. The unlikelihood, therefore, of the development of cholecystitis merely from the presence of organisms within the bile leaves the lymphatic route as the one which is perhaps most probable in many, if not in the majority, of cases. Such a lymphatic infection would begin in the deeper layers of the wall of the gall bladder rather than in the mucosa; and apparently this hypothesis coincides with the pathology found in cases of early gall-bladder infections in the human. The emphasis so commonly placed on the

appearance and changes in the mucosa of the gall bladder would seem, therefore, to be misdirected.

I wish to acknowledge with gratitude the kind assistance of Dr. E. A. Graham under whose supervision this work was done.

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TRAUMATIC SHOCK; SOME EXPERIMENTAL WORK ON CROSSED CIRCULATION[1]

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IN the recent literature on the subject, a great deal of attention has been directed toward the theory that certain toxic substances taken up by the circulation from a traumatized area might be a factor in the production of the clinical picture known as "traumatic shock." This conception of the etiology of traumatic shock gained many adherents among both physiologists and clinicians during the intensive investigation stimulated by the World War, and a very extensive literature on this subject has grown up. The evidence at hand in favor of this theory, and a complete review of the literature, is furnished by Cannon[2] in a recent article.

Since Fredericq[3] in 1890 introduced the principle of crossed circulation, there have been several attempts to attack the problem of traumatic shock by means of some such method. The most elaborate technique proposed is one described by Bazett and Quinby.[4] According to their method, the entire systemic circulation may be crossed from one animal to another by means of an anastomosis made at the level of the ascending aorta. They hoped that this method might be adapted to the study of shock, but found that the animal in the better condition bled into the other so that no definite evidence could be obtained. Crile[5], during his studies on the effect of trauma on the brain cells, crossed the circulation of two dogs by means of an anastomosis between the carotid artery and the jugular vein; and Janeway and Ewing[6] carried out somewhat similar experiments in an attempt to supply the dog that was being traumatized with blood from a normally beating heart. These latter investigators found their experiments unsatisfactory because the recipient drained off so much blood that the donor soon became exsanguinated.

If substances capable of producing shock circulate in the blood of a traumatized animal, it should be possible by means of crossed circulation to produce shock in a non-traumatized animal. The difficulty in the experiment lies in the fact pointed out above that as soon as the traumatized animal develops the low blood pressure characteristic of shock, its vascular system acts as a reservoir which retains the blood from the normal animal. To avoid this difficulty, no attempt was made to cross the entire circulation; but the lower extremity was selected for traumatization, and by means of anastomoses between the aortæ and the venæ cavæ just above the bifurcations the circulation of that area was taken over by a normal animal. (See diagram, Fig. 1.)

METHOD

Cats were used as the laboratory animals, and as far as possible animals of equal size and weight were selected. All the experiments were carried out under urethane anæsthesia. Eight cubic centimeters of a 25 per cent solution per kilo of body weight, administered by the stomach tube, were found to give a very satisfactory grade of anæsthesia. The operative procedures were performed on heated tables, and the body heat of the animal was kept up during the experiment by means of an electrically heated pad.

OPERATIVE PROCEDURES

As soon as the animals were fully anæsthetized, cat A (diagram, Fig. 1), the animal that was to take over the circulation of the traumatized area, was prepared for the experiment in the following manner. A mid-

[2] Cannon, W. B. Arch. Surg., 1922, iv, Jan.
[3] Fredericq, L. Arch. de Biol., 1890, x, 127.
[4] Bazett, H. C., and Quinby, W. C. Quart. J. Exper. Physiol., 1914, vii, 11.
[5] Crile, G. W. Am. M. Ass., 1901, lvi, 7.
[6] Janeway, H. H., and Ewing, E. M. Ann. Surg., 1914, lix, 158.

[1] From the Laboratory of Surgical Research, Harvard Medical School.

line incision was made in the neck, and a tracheal cannula inserted. Through the same incision, the carotid artery was prepared for the insertion of a cannula. Next, a low, mid-line, abdominal incision was made and the intestines were carefully packed to one side with gauze sponges wet with warm normal salt solution. This procedure exposed the lower portion of the abdominal aorta and the inferior vena cava. These vessels were dissected out so that they were freely mobile for a distance of about 3 or 4 centimeters and they were ligated at the level of the pelvic brim. The abdominal incision was then temporarily closed by means of clamps.

A low mid-line abdominal incision was now made in cat B (diagram, Fig. 1) and the abdominal aorta and inferior vena cava treated in the same manner as described for cat A, except that the vessels were ligated about 4 centimeters above the pelvic brim. The abdominal muscles were then cut through between the clamps, a tight ligature was placed around the lumbar muscles, and the lower extremity was amputated just above the ligature. The upper extremity of cat B was discarded at this point. In the early experiments the lower extremity was not amputated; but this procedure was necessitated by the fact that the large veins in the spinal canal itself furnished a route for the blood from Cat A to find its way into the circulation of cat B. In the later experiments, following amputation, the spinal canal was packed with bone wax to prevent hæmorrhage, and the stump was wrapped with gauze sponges soaked in warm saline solution. Before the crossed circulation was established, the amputated legs were traumatized by means of repeated blows with a hammer over the fleshy, muscular portion of the thighs, according to the technique described by Cannon and Bayliss.[1] Care was taken not to fracture the femur, and an effort was made to preserve the skin intact and to avoid injury to the femoral artery and vein.

The anastomosis was carried out by means of paraffined-glass cannulæ.[2] These cannulæ

Fig. 1. Diagrammatic representation of the crossed circulation. The upper extremity of cat *B* is discarded immediately after the amputation has been carried out. *a*, Aorta, cat A; *v*, vena cava, cat A; *a'*, aorta, cat B; *v'*, vena cava, cat B; *c*, cannula.

were 10 centimeters in length; the aperture of the arterial cannula was a little over 1 millimeter in diameter, of the venous about 3 millimeters. The blood flow was controlled while the cannulæ were being inserted by means of rubber protected serrefine clamps. As soon as the cannulæ were in place, but before the clamps were removed from the vessels, a cannula connected with a mercury manometer was inserted into the carotid artery of cat A and a record of the blood pressure was started, which continued throughout the experiment. As soon as a preliminary blood pressure reading had been recorded, the serrefine clamps were removed, establishing crossed circulation.

DISCUSSION

The animal was considered to be in a state of shock when a persistent systolic blood pres-

[1] Cannon, W. B., and Bayliss, W. M. Med. Res. Com., Sp. Rep. Ser. No. 26.

[2] The original model for these tubes was very kindly furnished by Dr. Beth Vincent.

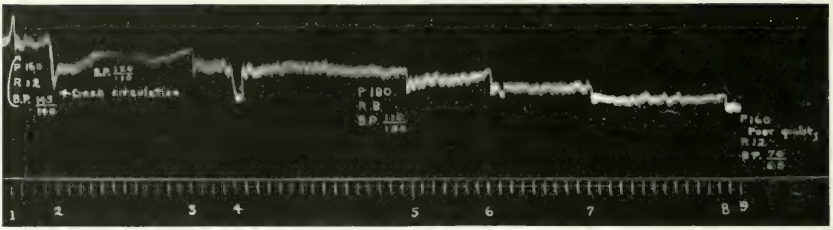

Fig. 2. Experiment No. 37. Weight of cat 3.1 kilograms. Urethane anæsthesia. The time intervals represent minutes. (1) Preliminary blood pressure reading 145–140. (2) crossed circulation established; (3 and 6) gentle massage of traumatized legs; (4) constriction of vein at point of anastomosis; (5, 7, 8) clot washed out of carotid cannula; (9) termination of experiment, blood pressure 70–65. The animal in a rather severe degree of shock.

sure of below 70 millimeters mercury was recorded. The character and rate of the pulse and respiration, the color of the mucous membranes, and the general condition of the animal, were also taken into consideration.

Figures 2, 3, and 4 show a typical blood pressure record taken during the progress of an experiment. The time intervals recorded at the bottom represent minutes. It will be observed that immediately upon establishing the crossed circulation a sharp fall in blood pressure is recorded. In most instances this is followed by a rise (Fig. 2). This is probably a purely mechanical factor and is dependent upon a sudden increase in the vascular bed to which the circulation soon adjusts itself. The progress of events from this point varies in different cases. In some instances a very gradual fall in blood pressure sets in at once and continues without interruption until the shock level is reached; usually in about 20 to 30 minutes (Fig. 3). In other cases the blood pressure maintains a fairly constant level, or may even show a slow rise, for a period of about 20 minutes, this in turn being followed by a gradual fall, which continues until the animal is in a state of shock (Fig. 2). It was noted that manipulation of the traumatized limb, or even gentle massage of the traumatized area, had a very depressant action on the blood pressure (Fig. 2),—a fact that had been pointed out by previous observers. Trauma of a more severe nature, such as that carried out in the preliminary traumatization, always produced a sudden marked drop in pressure (Fig. 4). In a few cases the animals developed no evidence of shock, and the blood pressure readings were well above the shock level at the end of an hour and a half, when the experiments were concluded.

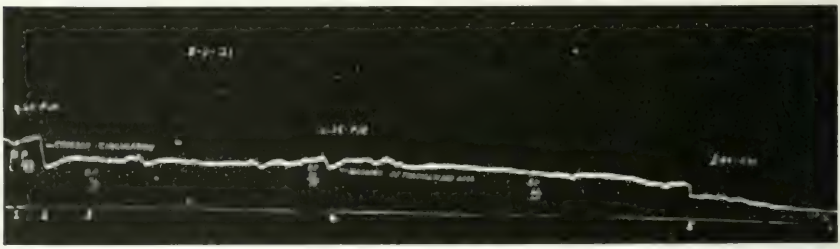

Fig. 3. Experiment No. 1. Weight of cat 3.1 kilograms. Urethane anæsthesia. (1) Preliminary blood pressure 100–65; crossed circulation established. (2) blood pressure 140–80. (3) gentle massage of traumatized legs. (5) clot washed out of carotid cannula; (6) cat in a moribund condition, blood pressure 20–18. Experiment terminated 44 minutes after the crossed circulation had been established.

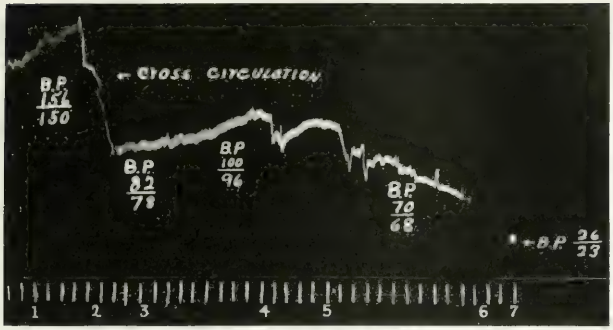

Fig. 4. Experiment No. 29. Weight of cat 2.2 kilograms. Urethane anæsthesia. The time intervals represent minutes. This tracing illustrates the very marked depressant effect on blood pressure produced by additional trauma of the injured muscles. (1) Preliminary blood pressure reading 156–150; (2) crossed circulation; (3) blood pressure reading 82–78; (4, 5, and 6) additional trauma; (7) experiment terminated. Cat in a moribund condition, blood pressure 26–23.

At the termination of the experiment the traumatized limbs were always autopsied. The blood vessels were dissected for any evidence of clot; and the traumatized muscles were examined in order to rule out any massive hæmatoma as the cause of the fall in pressure. It was our experience that the traumatization resulted in very little hæmorrhage into the tissue.

As controls, experiments were carried out in which the major traumatic procedure was omitted; that is, the lower extremity of cat B was amputated and the crossed circulation was established without any traumatization of the thigh muscles. Figure 5 shows a typical result of this type of experiment. The fall of blood pressure, followed by a rise, which occurs immediately after the establish-

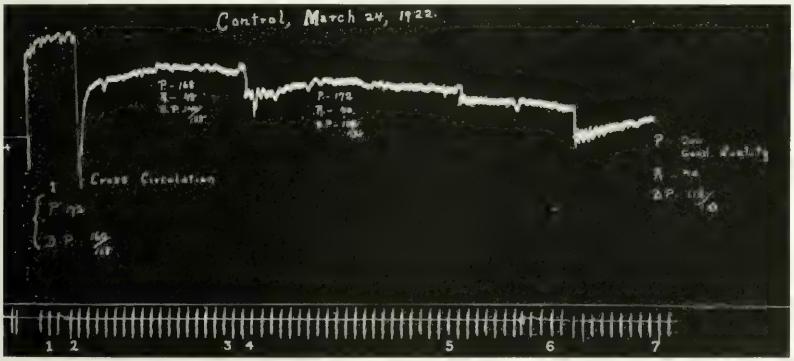

Fig. 5. Experiment No. 38 Control. Weight of cat 3.0 kilograms. Urethane anæsthesia. The anastomosis was effected without the major traumatic procedure. The time intervals represent minutes. (1) Preliminary blood pressure reading 160–158; (2) crossed circulation established; (3) blood pressure 140–138; (4) vein constricted to test patency; (5) clot washed out of carotid cannula; (6) stomach appeared somewhat dilated, relieved by passing a tube; (7) experiment terminated. The animal in good condition. Blood pressure 112–110.

ment of the crossed circulation has already been described. It will be noted that after this rapid adjustment of the circulation has taken place, the blood pressure remains well above the shock level and the animal's general condition is good at the termination of the experiment.

RESULTS

In summarizing the results, none of the earlier experiments in which the factor of collateral circulation might have been a source of error has been included; and all the experiments in which mishaps in technique might have influenced the results have also been ruled out.

Seventeen complete experiments were carried out. In 12 cases the major traumatic procedure was followed: that is, traumatization of the muscles of the thigh. In 9 of these experiments cat A, the animal which, under the conditions of crossed circulation, had taken over the circulation to the traumatized area, developed the typical picture of shock: the blood pressure fell to the shock level, in most instances, within 30 minutes of the time the crossed circulation was established.

In 3 cases no shock was produced—the blood pressure remaining at about its initial level when the experiment was stopped at the end of an hour and a half.

Five experiments were carried out as controls, in which the major traumatic procedure was omitted: the lower extremity of cat B was amputated and the crossed circulation established without any trauma of the thigh muscles. In four of these experiments cat A showed no evidence of shock at the termination of the experiment. In one case, at the end of an hour and a half the blood pressure had fallen to 70 millimeters mercury and the animal was considered to be in a state of shock.

In studying the etiology of traumatic shock, we realize that some of the most fundamental problems of physiology are involved and that very guarded conclusions should be drawn from any limited number of experiments. We feel, nevertheless, that evidence has been obtained suggesting that some substance capable of producing shock is taken up by the circulation from a traumatized area.

We wish to take this opportunity to thank Dr. W. C. Quinby and Dr. R. I. Lee for their helpful suggestions and criticism.

A PATHOLOGICAL STUDY OF A CASE OF CIRSOID ANEURISM

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THE literature with regard to cirsoid aneurism is rather meager. The reports for the most part simply state the clinical aspects of the case, the method of treatment, and the result. Many of them are cases presented at medical society meetings and the records appear in local journals under society proceedings. An occasional author has reviewed the literature but only rarely have the pathological findings been described. The cases have been so infrequent that each author has been able to add but a single case to those which he has reviewed and the pathological description has therefore been specific rather than general or composite. In the literature of the last 30 years, out of 29 reports of cirsoid aneurism available, there are only two with a detailed pathological description. These are by Wagner (74) in 1894 and Keppler (32) in 1912. Inasmuch as these differ in some essential details from each other and from the case which I have had the privilege of observing, it seems worth while to report my findings. The differences may possibly be explained by a difference in the mode of origin of the tumor or the stage in which the tumor is found.

PATHOGENESIS

According to the opinions expressed in Wagner's review, cirsoid aneurism may arise in four different ways: (1) from a nævus or telangiectasis, (2) from a deep congenital anomaly of blood vessels (which may be of the same nature as a nævus), (3) from a single severe trauma, or (4) from a long-continued series of slight traumata. The first, third, and fourth modes of origin seem to be clearly borne out by case histories. The second is given as the probable cause in all other cases. This is, of course, theoretical and would be difficult to demonstrate. Wagner's article indicates that the congenital origin is represented in about 80 to 90 per cent of the cases and the traumatic in 10 to 20 per cent. More recent reports of individual cases seem to stress the traumatic factor, and Routier (63) has added the theory of a fifth causative agent, namely, an arteritis following an acute inflammation. He presents a case following the defervescence of a "phlegmon" and Reverdin (61) supports the theory with a case following a general "typhoid-like" infection.

The essential pathological condition is a pulsating tumor caused by an anastomosis between small arteries and veins without the interposition of capillaries. This was pointed out by Broca (79) in 1869, who is quoted by Wagner (74) as follows: "Some of the vessels showed a direct communication between artery and vein which indicates that these vessels must first have been capillaries and then by dilating changed either to arteries or veins." (It is not stated whether this gross finding was or was not confirmed microscopically.) This is believed by Wagner to be due to a perversion of development and, therefore, he considers the lesion to be a new-growth.

If Broca's theory of origin, as interpreted by Wagner, be true of cirsoid aneurisms of the congenital type, one is tempted to ask what factors determine whether these capillaries in their perverted growth shall develop into arteries or into veins or into some composite form. It is quite possible that the pathological picture of the tumor will vary according to whether one or the other element predominates in the perverted development. This may account for the fact that Wagner found only arteries in his specimen. He describes all of the vessels as having normal internal and external elastic lamellæ and adds: "I could not distinguish vessels which definitely characterized themselves as veins." Also Fabian, who gave the microscopical report in Keppler's (32) review, describes just one type of vessel which, from his description, seems to be an artery. In the case in hand, however, there are not only definite arteries and definite veins but intermediate forms, and Broca, grossly at least, definitely describes both arteries and veins. In the congenital

Fig. 1. Photograph of the patient before operation.

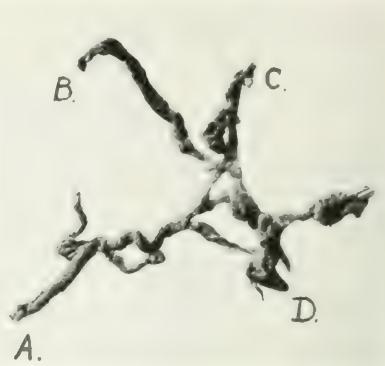


Fig. 2. A portion of the tumor teased apart, showing four relatively large vessels connected by a network of smaller vessels. ×2.

types it would seem reasonable to suppose that there are many communications between the arteries and the veins.

In the traumatic types it is possible that the communications may be made between vessels larger than capillaries and that physical factors may be more instrumental than those unknown factors causing perversion of capillary growth. It is likely also in the traumatic types that the communications would be fewer than in the congenital types. Thus the former approach more nearly to the true arteriovenous aneurism in which the communication is single between an artery and a vein of large caliber. The same would probably be true of a cirsoid aneurism of inflammatory origin.

If the capillaries simply dilate and do not develop the true muscular walls of arteries or veins, we have a simple non-pulsating cavernous hæmangioma. It is very evident in the literature that cirsoid aneurism has been frequently confused with cavernous hæmangioma and with arteriovenous aneurism. It is quite possible that there may be intermediate types of congenital cirsoid aneurism on the one hand and traumatic on the other which may present characteristics of these other forms of vascular disease.

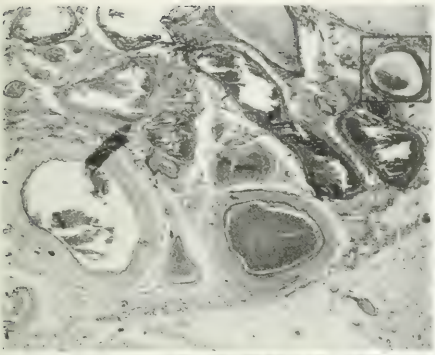
This type of tumor has a great predilection for the head. V. Goehring (81), who collected 32 cases, found 23 on the head, 1 on the neck and 8 on the upper extremity. Schueck (80), who collected 87 cases, found 80 on the head, 1 on the neck and 6 on the extremities. Monnier (48) reported one case on the trunk. The predilection for the head is explained by some, with seeming plausibility, to be due to the increased vascularity of the part and the nearness to the heart and the consequent increase in blood pressure. Another important point that has been mentioned is the exposure of the head to trauma.

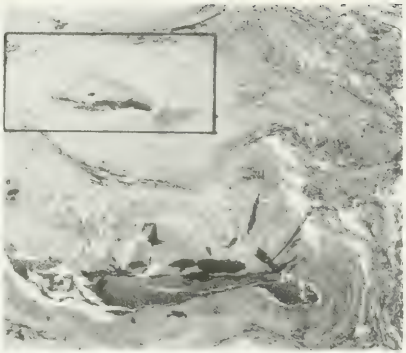
CASE REPORT

Hospital No. 1743. Ma Yu T'ang; nationality, Chinese; occupation, soldier; age, 34; admitted February 23, 1912. *Chief complaint.* Swelling under the chin, duration 9 years. *Present illness.* Swelling—onset gradual 9 years ago. When first noticed it was the size of a small bean. At that time the patient felt it pulsate. Gradual increase in size until 2 years ago when it began to grow more rapidly. It has always been soft and has not changed in character since the onset. Pulsation was noted at onset and has always been present. Within the past 2 years it has been annoying. Pain, none. Functional disturbances, none. General symptoms—none.

Patient gives no history of trauma, of venereal disease, of severe illnesses, or of other surgical conditions. He is a soldier, leads an easy, comfortable life, following the routine military activities. No known trauma to region involved. *The family history* is irrelevant.

February 23. Admission note (Fig. 1.): "Physical examination negative except for local condition.





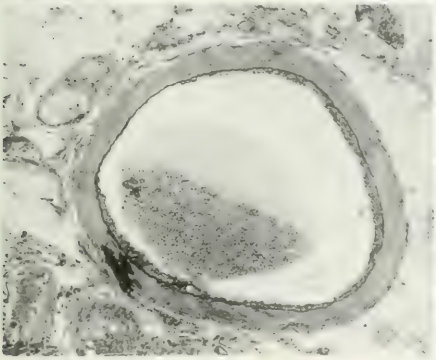


Fig. 3a (above, left). Photomicrograph of a portion of the cross section of the whole tumor, showing vessels of different types. Weigert-iron-hæmatoxylin-Van Gieson triple elastic stain. ×25.

Fig. 3b (above, right). Another portion of the same cross section showing vessels of still different type. ×25.

Fig. 4 (below, left). Photomicrograph of one of the arteries shown in Fig. 3a, included in the square, showing detail. ×100.

Fig. 5 (below, right). Photomicrograph of one of the veins shown in Figure 3b, included in the oblong, showing detail. ×75.

There is an irregular shaped swelling beneath the chin extending from just to the right of the midline to the region of the anterior border of the left submaxillary gland. It measures 5 by 3½ centimeters with the long axis transverse. With lateral observation a systolic pulsation is seen. The skin is not discolored over it but there seem to be serpiginous elevations beneath the skin, suggesting the presence of blood vessels. On palpation, the swelling is found to be soft. It feels like a tangle of blood vessels and is spongy. On continuous pressure the size of the swelling can be materially reduced, but it quickly returns to its original size by systolic increments of blood. No thrill is felt and no bruit heard on auscultation. The skin is loosely attached to the surface of the mass which in turn is fixed to the deeper structures. Pressure over the left facial artery at the jaw diminishes the pulsation slightly. Pressure over the left lingual artery does the same but pressure over both together does not completely control the pulsation. The facial artery does not seem to be materially increased in size. Floor of the mouth negative. Opinion. It is most likely a blood-vessel tumor of the cirsoid aneurism type."

February 24. Operative note: "A curved incision was made from the point of the chin down around the posterior margin of the tumor and outward for a short distance beyond the greater cornu of the hyoid bone. Beneath a thinned-out platysma a tangle of pulsating blood vessels was found posterior to the mandible, overlying the mylohyoid muscle and slightly overlap-

ping the anterior belly of the digastric in front and the submaxillary gland behind. It was decided to ligate the lingual artery which seemed to be the chief source of blood supply for the tumor. This was reached through Lesser's triangle. This ligature diminished the pulsation of the tumor by at least one half. The tumor was then dissected from below upward. Large vessels 2 to 3 millimeters in diameter were seen piercing the mylohyoid muscle and entering the base of the tumor. They were not pulsating and were evidently branches of the previously ligated lingual artery, either the suprahyoid or an aberrant branch. On dissecting upward, somewhat smaller pulsating vessels were seen entering the left side of the tumor, evidently the submental branch of the left facial artery. From the right side came the corresponding branch of the right facial and from above several smaller radicals from the inferior labial branch of the left facial. All of these vessels were ligated with fine silk. The skin was then closed by suture."

The wound healed primarily. Soon after leaving the hospital the patient was sent by troop movements up into Mongolia. Letter sent out for information regarding the condition of his health received no reply.

Pathological findings. Gross examination. "The specimen consists of a small, flat, oval mass of tissue measuring 3½ by 2½ by 1½ centimeters. On one side there is an oval piece of skin somewhat smaller than the mass itself. Beneath the skin there is a thin layer of muscle. On cross section, it is seen that the mass is made up of tortuous blood vessels, varying in size from 1 to 3 millimeters. The walls of these blood vessels are also variable in thickness. Some are relatively stiff and circular, while others are softer and flatter. Some contain blood while others are empty. Some are light and some dark in color. By teasing the vessels apart the relations are made more apparent. At one point a light colored vessel is seen to enter the side of a tortuous, dark colored vessel. At a point where these run parallel, a cross section is made to determine whether these are arteries or veins or both. (Fig. 6.) In another part a small thick-walled vessel is seen to enter a large thinner-walled vessel which is slightly sacculated at the point of junction. Another cross section is made of these vessels. (Fig. 7.) On the deep surface three vessels are seen entering the tumor. Two of these are thick-walled while the third is thin and collapsed. The vessels of the tumor are held together by connective tissue and fat, and in this substance a few small thick-walled vessels are seen. When the connective tissue and fat have been cut away from a part of the mass (Fig. 2), it is seen that there are three types of vessels. One type is relatively straight with thick but even walls. The caliber varies from 2 to 3 millimeters. The other type is varicose and tortuous with walls of varying thickness. These two types are connected by the third type, namely, vessels relatively small (not more than 1 millimeter in caliber) which form a network between the larger vessels. Sections are taken from four of the large vessels entering this network.

Microscopic examination. A cross section of the whole mass (Fig. 3) shows many large and small blood vessels varying in size from 0.1 to 3 millimeters. Almost all of them have rather thick walls. There are strikingly few capillaries. There are no large blood spaces. The vessels are held together loosely by relatively acellular connective tissue and fat. Some of the vessels are full of blood while others simply have a few red cells clinging to the walls. The blood mass in those full of blood has retracted somewhat from the wall and takes a scalloped appearance. No thrombosis is seen. The Weigert-iron hæmatoxylin-Van Gieson triple stain shows the elastic tissue exceedingly well. About one-third of the vessels have complete internal elastic membranes and about one-third have none at all (Figs. 4 and 5). These I think may be definitely called, respectively, arteries and veins. In the other third, however, the internal, elastic lamella is imperfect. In some of these vessels there is a heavy layer of elastic tissue on one side which frays out or becomes reduplicated or else disappears entirely, on the opposite side. In others, there are simply a few strands of elastic tissue in the general region of an internal, elastic membrane. The cross sections show considerable variation in the thickness of the wall of the individual blood vessels. This is less marked in the frank arteries than in the other vessels. In the arteries (Fig. 4) the variation consists chiefly in the thickness of the intima or in the region between the internal, elastic membrane and the media. The intima in all sizes of arteries varies from a single layer of endothelium to a layer one-third to one-half as thick as the media itself. This variation in thickness may develop suddenly so as to present an oval body projecting into the lumen. The Van Gieson stain shows that this redundant tissue is made up of both connective tissue and smooth muscle. With the elastic tissue stain a few fine, elastic, tissue fibers are also seen here. In a few arteries, similar tissue is found just outside the internal, elastic membrane pushing the latter toward the lumen. These masses are distinctly cellular. The media of the frank arteries is of fairly uniform thickness and is composed of smooth muscle with a small amount of connective tissue and elastic tissue. The external, elastic membrane is entirely missing in most of the vessels and is represented only by a few scattering elastic fibers in the others. The adventitia varies somewhat in thickness according to the size of the vessel, but in any individual vessel it is fairly uniform.

The other vessels (Fig. 5) in general show much more distortion of their walls than do the frank arteries (Fig. 4). In cross section the lumen of some of them is reduced to a narrow slit or distorted space. Although it is more difficult to distinguish the intima from the media in the vessels in which the internal elastic membrane is defective or absent, the distortion seems to be present chiefly in the intima but also to some extent in the media. In some vessels there are great, oval masses of tissue projecting into the lumen. This tissue is composed of both smooth muscle and connective tissue with a few elastic fibers and seems to

Fig. 6 (above, left). Photomicrograph of the first pair of large communicating vessels which are of the arterial type. (The broken vessel is a continuation of the large one turned upon itself.) ×25.

Fig. 7 (above, right). Photomicrograph of second pair of large communicating vessels of the venous type. ×25.

Fig. 8 (below, left). Photomicrograph of *A*, Fig. 2, one of the large vessels entering (or leaving) the network of smaller vessels. It is of the arterial type. ×50.

Fig. 9 (below, right). Photomicrograph of *D*, Fig. 2, one of large vessels leaving (or entering) network of smaller vessels. It shows three vessels of venous type. ×50.

indicate a hypertrophy rather than a simple scarring. In other vessels, there is a general infiltration of the media with connective tissue. At the same time the muscular tissue itself is thicker than in normal veins. In these vessels the external, elastic membrane is missing or fragmentary. The adventitia is perhaps in general thicker than in the vessels first described.

The endothelial lining of all types of vessels varies, but the differences do not correspond to the type of vessels. In some, the endothelial cells are flat and spread apart. In others they are rounder and closer together. This does not correspond to the state of dilatation, and the impression is given that a proliferation has taken place.

There is very little evidence of degeneration in the tissue. The nuclei stain well, and there are no deposits of fat or calcium in the vessel walls nor is there any hyaline degeneration. There is also very little evidence of infection other than the presence of moderate connective tissue infiltration. There is no cellular infiltration. Attention has been called to the cellular infiltration or degeneration of nerves but in the few small nerve fibers which are present there is nothing abnormal evident.

The sections from the two pairs of large communicating vessels show the first pair to be alike. Each vessel has a fairly complete, internal, elastic membrane and the walls are of uniform thickness. They resemble arteries (Fig. 6). The second pair are also alike but are of a different type from the first pair. The walls are thinner and more distorted, and there is no internal elastic membrane present. They resemble veins (Fig. 7). We have then no evidence of direct communication between large vessels of different type.

The sections made from the four large vessels communicating through a network of smaller vessels (see Fig. 2) shows *A* to be of the arterial type (Fig. 8) with an almost complete, internal, elastic membrane

and an even muscular wall. *B* is more of the intermediate type but with a small amount of real internal, elastic membrane which tends to classify it as an artery. *C* is a thin-walled vessel without elastic membrane presenting the characteristics of a vein, while *D* shows a group of thin-walled vessels all of the venous type (Fig. 9). We have, then, fairly large vessels of different types communicating with each other through a network of smaller vessels.

Grossly this case represents a relatively small cirsoid aneurism probably of the congenital type, in a rather unusual location which made it easily amenable to surgical treatment.

Microscopically the case differs from the one described by Fabian (32) in that in his case all of the vessels seemed to be of one type, thrombosis was frequent and, where the thrombus touched the wall, the intima was absent. No mention was made of any proliferation of the endothelium. Also there seemed to be evidence of degeneration in the intimal nodules and in the media as represented by peculiar "spot" in areas where the nuclei stained poorly. The intimal masses showed no details of structure. In his case there was a striking lack of elastic tissue in the vessel walls except in the well-developed, internal, elastic membrane.

This case differs from that described by Wagner (74) in that in his case all the vessels seemed to be arteries. The external as well as the internal, elastic membranes were well defined. Some of the smaller vessels were completely obliterated by the intimal nodules. Perivascular, round-celled infiltration was frequently seen.

The present case agrees with Wagner's in its demonstration of definite proliferation both in the endothelium of the vessels and in the intimal nodules, and also in the absence of evidences of degeneration. It seems justifiable to suppose that the reason why vessels of different types are found in this case and not in the others is that in this instance the proliferation took place in those elements which embryologically represented both veins and arteries. It may be that the partial development of an internal, elastic membrane in the intermediate types came either as a perversion of arterial development or arose in veins in response to the pulsations carried through the arteries directly into the veins. The fact that in the arteries the changes are relatively slight while in the veins or intermediate vessels the changes are striking, would seem to indicate that the excessive proliferation is due to a demand made by the physical forces of the abnormal circulation upon vessels not adapted, or poorly adapted, to withstand those forces. At the same time proliferative changes are taking place in the endothelium of the well-formed arteries as well as in the veins, as the pathological process continues and the tumor enlarges. Possibly the same factors which initiated the process are still going on. If this is a real new-growth, the nature of this process is at present as mysterious as it is for any other form of new-growth.

Further light will undoubtedly be brought to bear upon this interesting subject by the description and study of other cases. The clinical aspects are fairly clearly understood but the pathological processes still need further elucidation.

I wish to express here my very great appreciation to Miss Dorothy Gordon, of the Central Pathological Laboratory, Peking Union Medical College, for her great care in the difficult preparation of the slides.

A complete bibliography of the literature as given in the *Index Medicus* since 1880 and the *Quarterly Cumulative Index* is appended. The articles which are starred have been available for this review. To this list are added a few other references quoted by some of the indexed authors.

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COMPENSATORY HYPERTROPHY OF THE FIBULA

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In recent literature on the surgery of bone, there is considerable reference to "Wolff's law." Innumerable laboratory experiments have established the fact that growth of bone varies with the need for it. It is probably a general law that growth of every tissue in the body is proportionate to the demand made upon it, at least when the change is gradual. This is certainly the case with fibrous tissue, as may be seen in the elongated, enormously strong capsule of an old-standing congenital dislocation of the hip joint.

The case to be related provides such an experiment *in corpore vivo*, and as it shows an extreme degree of natural adaptation to requirements it seems worth placing on record.

No discussion of the interesting subject of the mechanism of hypertrophy will be undertaken, except to suggest that it may be possible to work out, on mathematical lines, the rules determining the activity of the osteoblasts, following up the interesting work of Dendy and Nicholson, on the osteoblasts of sponges, demonstrating the extreme sensitiveness of these cells to vibrations. Reasoning by analogy, as Keith puts it, "Osteoblasts at all times build and unbuild according to the stresses to which they are subjected."

N. B., male, age 25, Russian, came complaining of pain and swelling in the right tibia. His history was that, at the age of 12 he got "a cold in the right knee joint," with swelling and pain. Three months later the leg was opened up and took 6 months to heal. Since that time he has been walking upon the leg. He had worked in a general store until the outbreak of the war. He was mobilized with the Russian army in 1914 and served until the withdrawal of Russia from the Allied forces. He came to Canada a year ago. He has been in the habit of walking 5 or 6 miles daily. During the war he had not been actually in the line, but was employed in clerical work just behind the front. He states that on one occasion he took part in a sudden retirement, during which he walked 30 miles in one day, carrying his share of equipment.

On examination the right tibia showed extensive longitudinal scarring. About 3 inches below the upper margin of the tibia a sinus was present, and the surrounding tissue was somewhat inflamed. This was thoroughly opened up and healed uneventfully. The tibia was observed to be dislocated behind the femur. There was considerable instability of the knee joint, lateral and rotatory motion being considerable in the fully extended position. Roentgenograms revealed a very interesting condition.

The lower extremity of the femur is somewhat porotic and the condyles somewhat flattened pos-

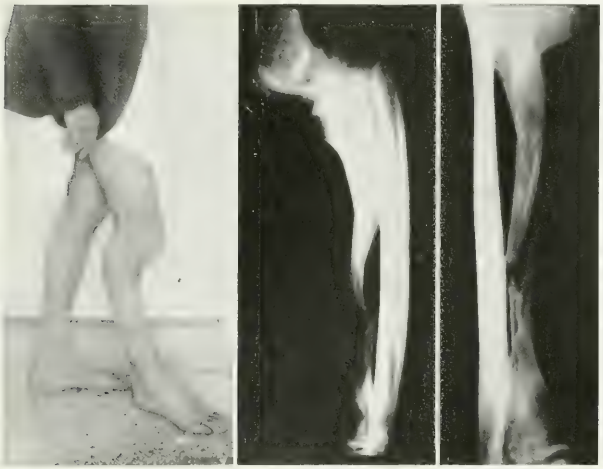

Fig. 1. Fig. 2. Fig. 3.

Fig. 1. Photograph of patient.
Figs. 2 and 3. Roentgenograms showing knee-joint and bones of leg. Anteroposterior and lateral views.

teriorly. The patella is also rarefied and about half its mass lies distal to a tangent to the condyles at right angles to the shaft of the femur. The tibia shows an ununited fracture just below the middle of the shaft. The fragments are conical and are completely separated from one another. The plane of the upper surface of the head of the tibia is inclined about 50° to the horizontal. The anterior and posterior portions are rarefied. The central portion is slightly depressed, makes contact in the extended position with the posterior aspect of the condyles, and this part of the bone shows distinctly greater relative density. The lower extremity of the tibia is much rarefied, particularly in relation to the medial malleolus. The plane of the distal surface of the tibia is inclined from above downward and outward about 15° to the horizontal. The fibula shows definite hypertrophy. The upper extremity projects proximal to the upper surface of the tibia. The head itself is little, if any, larger than the normal fibular head. The shaft retains, on the whole, its characteristic outline, although it is enormously thickened, and shows some backward convexity. Both cortex and medulla are increased in dimensions, notably the former. The anterior segment of the shaft shows cortical bone more than twice as thick as the posterior segment, i.e., it demonstrates the usual buttressing along a concavity. At the junction of the lower fifth with the upper four-fifths an additional buttress is seen projecting toward the tibia.

For 1 or 2 weeks after his recent operation patient used a cane, but he has now discarded this. During this time he complained of some discomfort at the back of the knee and about the site of the fracture of the tibia. This discomfort has now also disappeared.

Examination of roentgenograms in the light of clinical findings would suggest that the line of weight bearing must run from astragalus to lower extremity of tibia; from there through the inferior tibiofibular syndesmosis to fibula, upward through fibula to upper part of shaft, and from there partly through head of fibula, but mainly through head of tibia to femur. If this be so it will demand hypertrophy of the inferior transverse tibiofibular ligament, of the interosseous ligament, of the posterior ligament of the knee joint, and of the fibular collateral ligament.

It is of interest to speculate regarding the reason for the shape and the "pitch" of the proximal surface of the tibia. One may take it that the primary lesion was an osteomyelitis in the upper end of the tibia, and this may or may not have been accompanied by an effusion into the knee joint. If effusion there was, it cannot have been purulent, but was probably sufficient to permit of some backward dislocation without equal development of the elements of flexion or external rotation.

Thus, when walking was resumed there were three main stresses acting on the upper extremity of the tibia:

1. Posteriorly, the posterior ligament of the knee joint, and the semimembranosus with its fascial reinforcement to the posterior ligament of the knee joint;

2. Centrally, the downward thrust of the body weight transmitted through the condyles;

3. Anteriorly, the pull of the patellar ligament which is ultimately the pull of the quadriceps extensor.

Once the central thrust is displaced from acting in the long axis of the tibia, it becomes a shearing stress. If its point of application be displaced in front of the central point of the upper surface of the femur, the strain on the anterior stay becomes much greater than the strain on the posterior stay. Added to this is the fact that the anterior stay is mainly muscular, while the posterior stay is mainly ligamentous.

Now muscle is more extensible than ligament, as is seen in the anterior stay itself by the practically unchanged length of the patellar ligament. Hence while the posterior margin is anchored by the strong posterior ligament, the anterior margin is less completely anchored. This may account, to some extent, for the shape of the upper surface, although it is only reasonable to suppose that the original operation attacking the metaphyseal region from the front may have damaged the epiphyseal cartilage, and thus interfered more with the growth of bone anteriorly than posteriorly.

As regards treatment of the condition, patient was advised to carry on as long as possible. A bone graft to bring about union in the tibia is not called for, and on account of the large amount of scar tissue would probably be a failure.

Another measure which may have to be considered at a later date is an attempt to arthrodese fibula to femur. The only alternative would be amputation.

Hypertrophy of the fibula has been seen not infrequently in cases of permanent non-union of the tibia, the result of gunshot wounds in the late war. Such hypertrophy is seldom as pronounced as in the case herewith reported. In this case there is a double deficiency. The non-union of the tibia is backed by a posterior luxation at the knee joint. This twofold increase of stress, coupled with the fact that it dates back to childhood when bone is much more plastic than in adult life, probably accounts for the remarkable picture presented.

TRACTION FRACTURE OF THE LESSER TROCHANTER

By J. FREDERICK LANGDON, M.D., F.A.C.S., Omaha, Nebraska

BECAUSE of its rarity, rather than because of any diagnostic or therapeutic problems involved, the following case is reported:

A boy, age 12, came under my observation October 3, 1919, with the following history: While running home from school, suddenly he felt something "snap" in his right hip. He fell down, but was able to get up immediately. He stated that it was painful but not of undue severity. He was able to get home alone, a distance of one-half mile. He said his leg dragged, so much so that he had to take hold of his thigh with his hands and pull it forward in order to take a step. On arriving home, he complained of some pain, but his mother stated that he did not cry or make much fuss about it.

I first saw him 3 days after the injury. At that time, his mother stated that the boy was having no pain, but was not walking properly. On asking him to walk, he proceeded in a very unusual manner. He stepped forward on his left foot, then grasped his right thigh with his hands and drew it forward, after which he would bear his weight on the injured leg without any apparent pain, again stepping forward with the left leg. In this manner he crossed the room, stating that he felt no pain at all. Further examination revealed no swelling or discoloration about the hip joint or thigh. Deep pressure in Scarpa's triangle elicited pain, but not severe. There was no shortening of the limb. On lying down, the leg assumed a position of slight external rotation. Passive movements were normal in all directions, and not painful. The great trochanter was in Nelaton's line. The predominant sign seemed to be loss of active flexion of the thigh. When standing or reclining, the patient was unable to flex the thigh. Also, while sitting down, he was unable to raise the limb from the horizontal position (Ludloff's sign). Patient was removed to St. Joseph's Hospital, where an X-ray photograph showed a separation of the epiphysis of the trochanter minor.

Patient was put to bed and a plaster-of-Paris cast applied, immobilizing the hip and knee joints. The limb was placed in slight flexion and abduction. At the end of 3 weeks, the cast was removed and the patient allowed up on crutches, which were discarded at the end of 4 weeks. At the end of 6 weeks, the patient was discharged, restoration of function being complete.

In a thorough search of the literature, I am able to find only 24 cases reported up to October 1, 1921. Ruhl (1), of the Frankfort clinic,

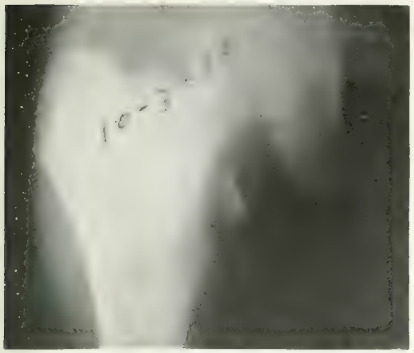

Fig. 1. Roentgenogram showing detachment of lesser trochanter, taken October 3, 1919.

Fig. 2. Roentgenogram showing complete healing, taken January 16, 1920.

recently states that, after an exhaustive study of the literature, he is able to find only 22 cases, including his own. Poston (2) mentions two cases, one of Usland and one of his own, which he gives in detail. This brings the record up to 24 cases, mine being the twenty-fifth.

ETIOLOGY

Ruhl's statistics show that 77.3 per cent occur between the ages of 10 and 20, the period when youth is particularly physically active. At this time, ossification is not complete, predisposing to epiphyseal separation. The essential etiological factor is sudden strain on the ilio-psoas muscle. This muscle is primarily a flexor. Its function is to draw the thigh and trunk together. Acting from above, it flexes the thigh, acting from below, the femur being fixed, it bends the trunk forward. The fracture under discussion occurs when the body is suddenly thrown backward in such a manner that its whole backward weight is thrown on one leg with a resulting sudden strain on the corresponding ilio-psoas. This muscle, in its efforts to right the body, undergoes a violent reflex contraction, with consequent detachment of the lesser trochanter. Feinan (3) expresses the belief that the production of this injury lies in the sudden backward strain thrown on an actively contracted ilio-psoas. He cites a case in which a patient falling forward suddenly threw his body backward, fracturing the lesser trochanter. However, a study of the history of the reported cases apparently indicates that in the majority of cases, at least, it is the reflex contraction of an overstretched ilio-psoas that is the causative factor. On this basis, our patient probably suffered his injury in the following manner: While running, as the result of slipping or stumbling, his body was suddenly thrown backward. In attempting to regain his balance, the whole weight of his body was thrown on one leg, his right leg. The right femur being fixed, the iliopsoas, by a sudden violent reflex contraction, attempted to flex the bent back trunk on the thigh. The trochanter minor was unable to stand the strain and was detached violently from the shaft.

SIGNS AND SYMPTOMS

Loss of active flexion of the thigh -partial or complete—is the predominant sign. Ludloff made the observation that, with the patient in the sitting position, flexion of the affected limb is impossible, though with the leg extended and the patient recumbent, flexion may be possible. The ability of the patient to flex the

limb when lying down is possible according to Ruhl, owing to the fact that in this position the rectus femoris and tensor fasciæ femoris may in some cases be of sufficient strength to produce flexion without the aid of the iliopsoas. Passive movements are usually possible in all directions. Such movements generally are painful, though in some cases the pain is not marked. In all cases there is pain elicited on pressure, in Scarpa's triangle. Swelling may or may not be present, depending mainly on the damage to the soft parts. Pain on walking is recorded as a constant symptom. The gait is affected in all cases, but usually not to any marked degree. Most of these patients are able to walk though with pain and a limp.

DIAGNOSIS

Before the advent of the X-ray, most of these cases were diagnosed fracture of the neck of the femur. With a typical history and loss of active flexion, especially in the presence of a positive Ludloff sign, the diagnosis is rarely in doubt, though the ultimate confirmation must rest with the X-ray.

TREATMENT

Treatment is simple and effective. Ruhl has shown that the origin and insertion of the iliopsoas are nearest each other when the femur is in slight flexion, outward rotation and abduction. The limb should be put in this position and fixed by means of sand bags, splints, or plaster cast. It should be thus immobilized for from 2 to 3 weeks, after which time, patient may be up on crutches. These may be discarded in from 1 to 2 weeks' time. The results are uniformly good, all cases having been reported as cured.

SUMMARY

The case herein reported differs in some respects from other cases hitherto published. Marked pain was conspicuous by its absence. At no time did it occupy the foreground in the clinical picture. When I first saw this patient 3 days after the injury, though loss of flexion was absolute, nevertheless he could bear his weight on the injured limb without any evidence of pain. Passive motions were possible in all directions and not painful. Loss of flexion in this case seemed to be more marked than in the cases previously published. Ruhl notes that the gait is only slightly affected in most cases. This, no doubt, is due to the fact that the iliacus portion of the ilio-psoas has an attachment to the shaft of the femur for a distance of 1 inch below and in front of the lesser trochanter, and by means of this attachment varying degrees of flexion are possible. In my case, the probabilities are that the complete attachment of the muscle to the shaft was torn away, together with the trochanter, resulting in total loss of flexion.

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1. Ruhl. Beitr. z. klin. Chir., 1920, 118.
2. Poston. Brit. J. Surg., 1921, Oct.
3. Quoted by Ruhl.

DEPARTMENT OF TECHNIQUE

TWO KINEPLASTIC PROBLEMS SOLVED

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AND

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WHEN in the month of July, 1917, I performed my first kineplastic amputation of the forearm, I did not imagine that it would yield encouraging results, as the method was so different from all prescribed methods. Later, more serious study, constant attention to the subject, and new cases convinced me of the great value of this means to secure better results than could be obtained by the ordinary methods. However, in order to overcome the standard opinions regarding the old fashioned, maiming methods, an atmosphere had to be created in favor of kineplastic amputation and results had to be produced to show the soundness of its principles.

Lack of faith in, and disdain for, the method, which is still in an evolutionary period, had its *raison d'être*, and it was logical that pioneer workers in the field should show results which were irrefutable, since a kineplastic victory meant a radical modification of old ways and means which had withstood the tests of time and experience. The campaign must needs be a strenuous one, not only because of the difficulty of securing patients in a city which is not a manufacturing one, but also because the prosthetic problem must be studied and solved in its entirety with the object of obtaining perfect results. To add to our difficulties there was very little to be found in the literature regarding the subject, and what articles were found described methods and apparatus very inadequately. This in addition to the lack of serious study of the problem of orthopedic mechanics helped to dampen the optimistic outlook which I had indulged in at this time.

The correspondence that I had carried on with Professors Vanghetti, Putti, Pellegrini, and others—Italians by birth as was the method—encouraged me to continue with the work, and their commendation of my endeavors encouraged me greatly and I felt compelled to accept their trust in my ability and go on, for I believed that success would crown my efforts. The description of the work that I had already done and the results as published by me brought about a great and hearty welcome from my distinguished colleagues. For this reason I do not believe it is necessary to describe here the governing principle nor the basis of kineplastic amputation which is known to every surgeon, but I shall limit myself to giving the latest progress made in solving the problem. Kineplastic amputation has won an indisputable place in the domain of surgery. Today no one can question its well-earned and tangible results. It remains for the future to perfect such results in their surgical and orthopedic aspects. Time can neither destroy nor impair what progress has been made, and this is especially true as the question involves problems of social, moral, and material interest.

The surgical technique which offers the greatest advantages, on account of its simplicity, is that proposed by Professor Pellegrini. Professor Pellegrini employs a skin-bridge and secures a first-class kinetic motor with the advantage that it works in any part of the system. Extrasegmental motors may be constructed to the side and transfer of power is effected from one part to another. A cicatrix is obtained at first, without destruction of bones or mutilation of other parts, and the patient is spared from suffering greater functional disability as he is provided with a common prosthesis. Simple, local, infiltrative anæsthesia may be used.

In spite of its advantages there are drawbacks to the method in that it is difficult to secure a motor of sufficient size, for the procedure pro-

Fig. 4. Double kineplastic amputation of the forearm.

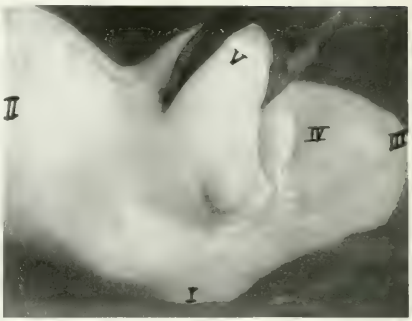
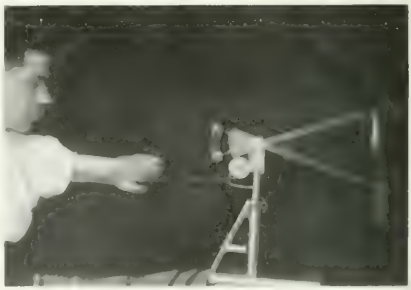


Fig. 5. Kineplastic stump. *I*, Elbow (olecranon); *II*, arm; *III*, forearm (stump); *IV*, skin from abdomen; *V*, motor with a tube inserted in its roomy eye.

duces a tunnel the diameter of which in no case may be larger than that of an ordinary pencil. Today we know that the larger and freer the eye of the motor, the better it will work. In other words, the pressure exerted by the prosthetic apparatus in its hold upon the skin of the tunnel will be better resisted by the skin when the surface to be adapted is large; that is to say, the larger the eye, the better the orthopedic results, because there is not the risk of ulceration of the skin and the pull is distributed over a greater skin surface. However, this drawback is not a serious one, since with good management in the re-education of the maimed individual and moderation in prosthetic exercise, tolerance and sufficient adaptation of the skin to the pressure caused by the connecting apparatus, are obtained.

My distinguished colleagues can appreciate what I have just said by observing the patient upon whom such an operation was done and who was furnished with a suitable prosthesis which he has worn now for 2 years.[1] In the early months

in making skin tunnel.



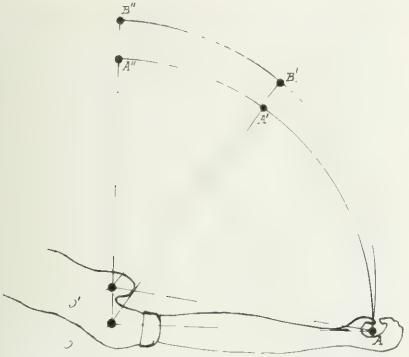


Fig. 7. The prothesis problem. *O*, Center of elbow; *O'*, center of motor; *A A''*, circumference of center *O*; *A B''*, circumference of center *O'*.

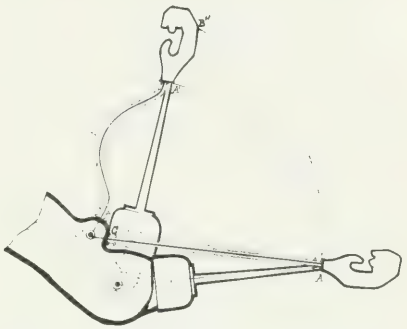


Fig. 8. Bowden. *O*, Center of flexion of elbow; *O'*, center of motor; *B*, Bowden.

the patient used the motor discreetly and conscientiously, since by overdoing in his manual work, he suffered pain and discomfort, and irritation and intolerance of the skin, which he was careful not to increase, removing the prosthesis and allowing the motor to rest. In the course of time, however, he was able to work for longer periods, and the tolerance of the skin became greater, so that now, the patient is able to do continuous and efficient labor without inconvenience.

Another drawback to the procedure is the making of motors which have limited power of movement, because the motor is not free as are the terminals. It is a sufficient estimate of the power of my patient's motor to say that the cicatricial process must fix the motor to the neighboring or adjacent tissues, and its freedom of motion will be diminished by these factors. Hence, it is advisable to begin active movements a few days after operation, in order to avoid injurious scars which might fix the motor to the tissues near, in a permanent or stable fashion. A terminal motor has greater freedom of motion and by exercise is inclined to improve in power and in extent of action.

Nevertheless and notwithstanding the circumstances stated, I feel satisfied with the Pellegrini operation; I believe that it is as excellent and that it is perfectly feasible to secure with it the end being sought, and such is the verdict of the patient himself, photographs of whom I present.

We will pass now to the other patient (Fig. 1) who suffered a double amputation of the forearms, and was provided with side motors which had the same function as end motors. From this case we shall be better able to judge of the superiority of the latter over the former. The motors have been constructed according to the technique described by Professor Sauerbruch. The motors work more slowly and with greater difficulty; their construction requires two or more surgical operations, and the technique of the skin plastic operation must be modified to suit the individual case.

The motors are made of the "muscular masses," the "power masses" being made in the first stage of the operation—the muscular protuberances, as Sauerbruch styles them—and they represent the future kinetic motors. In the sceond stage of the operation, the surgeon makes the motor eye, and effects its epidermization, thus transforming the "power mass" into a "kineplastic motor." For this purpose, the skin plastic is planned according to the disposition of the "power masses," and the suitability of the clinical case.

For our patient, Dr. del Valle built up in both forearms in the first stage of the operation, "power masses" out of the supinator muscles, the round pronator, sacrificing the deep muscles in the region as he considered them useless for the construction of the motors, and, as is natural, it was found necessary to cover over the stump surfaces with abdominal skin, by means of pendent tissues with pedicles. Once the power protuberances were obtained, then tunnelization was effected, by means of a technique which will be best understood by studying the schematic drawings (Figs.

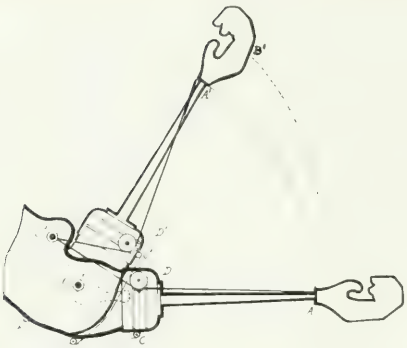


Fig. 9. Differential. *O*, Center of elbow; *O'*, center of motor; *D*, differential.

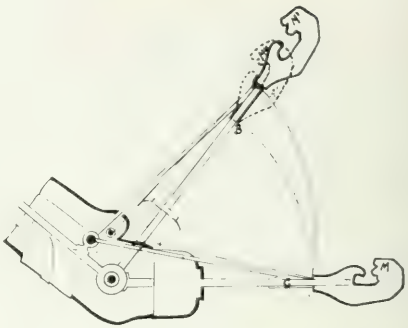


Fig. 10. The problem solved. *O*, center of elbow; *E*, center of motor; *O'*, motor; *A-B*, circumference of center *O*; *A-A'*, circumference of center *O*; *E-A*, stiff rod which propels the hand and causes it to slip along the axis; *B-A'*, distance gained.

2 to 4). The transplanted tissue grew without any difficulty, and 6 weeks later motor exercises were begun as well as the re-education and training of the muscle. The artificial hands were ordered from the Rizzoli Institute at Bologna, by favor of, and through, Professor Putti, director of the establishment.

As you may perceive, the quality of the motors is first-class so far as the mechanical construction is concerned—they are free and easy to manipulate, and besides the motor eye is of sufficient size to admit the index finger of my hand (Fig. 5) completely and easily. The kinetic power as measured with my ergograph shows a run of 4 centimeters with 15 kilograms weight—an exceptional result, which it would be difficult to obtain with Pellegrini's technique for the reasons given. In our motor the run is free from hindrances or cicatricial bridges, and it acts as do those of terminal pattern (Fig. 6).

The second part, or hand prosthesis, was adapted to the patient, the arm and forearm bracelets being constructed in the orthopedic workshops of the Public Assistance, whose intelligent director is Dr. Wildermuth, and through whose active help and assistance all difficulties were obviated. He collaborated efficaciously in the solution of highly interesting problems, as he had had training in orthopedic matters in German clinics and under the direction of Professors Bethe and Sauerbruch.

The problem of kineprosthesis was presented in its most difficult form in our case, as the motor was situated upon the forepart of the arm at the bend of the elbow. Surgeons universally agree that the construction of motors within the folds of the bend of the elbow is contra-indicated, for in such a position they would hamper the freedom of articular movements, since in maximum flexion movement would be hindered and the kinetic value of the motor destroyed. Notwithstanding this fact with which we were familiar before operating upon our patient, but relying on our clinical experience, we undertook the task and made a motor in spite of what our success might be; for we were well aware that the subject of kineplastic amputations is still in the experimental stage, that old methods are being revised, and new ones devised and that it is no longer possible to trust to precepts which we hitherto thought incontrovertible, even though such precepts were enunciated by masters of high standing and renown.

When the prosthetic apparatus had been made and fitted to our patient, the outer tractor of the hand was tightly stretched and joined to the kineplastic motor in the extended position. The patient was made to lift a wine glass which was taken hold of with the hand through contraction of the motor, and at the same time he was told to raise it to his mouth. In doing this, with the forearm half bent, the wine glass fell to the ground and broke to pieces. The patient said the glass fell because it had become loosened from his grasp, although the motor was taut or contracted.

In studying the case we soon realized that in bending the forearm, the distance between the motor and the hand was shortened; consequently, the tractor loosened and the fingers half opened

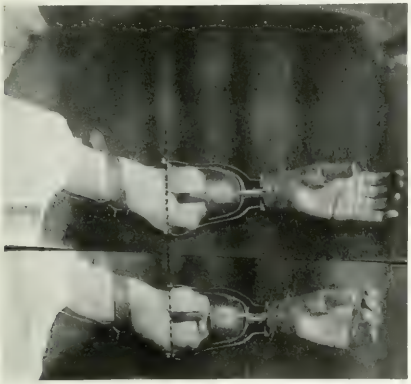


Fig. 11. Active flexion of the hand. Note displacement of the motor which is placed in the axis of flexion.

Fig. 12. Prothesis furnished to patient. (Rizzoli Institute, Bologna.)

and the glass dropped. Figure 7 shows, in a graphic form, the problem presented. It is manifest that the center of the elbow-bend O, does not correspond to the center of the motor O', which is higher up, its position depending on the distance between O and O'. In describing an arc of a circle the radius of which, OA, represents the length of the forearm, it is natural for the hand to take the positions OA' and $OA'A''$. On the other hand the center of the motor O' and its tractor, represented by the distance $O'A$, should follow the circumference $AB'B''$, with its center in O'; but as the hand is placed on A'' and not on B'', it follows that a slacking of the tractor ensues equal to the shortening of the distances OA' and $O'A''$, the differential index of which represents the distance $A''B''$.

The hand half opens and drops the object held because the outer tractor relaxes in spite of the fact that the motor still remains contracted. In synthesis, the problem should be solved by shortening the outer tractor, in a manner correlative, simultaneous, and in proportion with the flexion of the forearm. This adjustment should not therefore reduce the power of the motor nor make it less efficacious.

The elementary formula, which may be stated in the following words, the work is equal to the power multiplied by the distance covered, applied to the case, would show us that to obtain the same amount of work from the motor, we need only adjust the mechanism according to the variable element of the formula—the distance—since the motor must produce the same return in work. Any solution of a prosthetic problem which tends to reduce the motor power must be condemned.

In our first trial we used the mechanical appliance of the "Bowden" (Fig. 8) with a flexible willow tube B, fitted as shown in the sketch and fixed at both ends A, C. Within the tube runs the external tractor which joins the motor to the hand. It is easily understood that in flexion, the tube will bend correlatively with the shortening of the distance OA and OA', taking the curve indicated in B', and covering the difference $A'B''$.

The trial turned out badly in that the motor lost power because of friction of the external tractor inside the curved tube B, and the hand had not enough strength to grasp objects. Afterward we tried a mechanical appliance (Fig. 9) known as the "differential" which consisted of a little wheel the center of which, D, turned on a groove, being tied to the arm with a flexible but inelastic cord $D\ C\ F$. In producing flexion, the little wheel D slipped along the groove, and took the position D', gaining the difference C, D,

Fig. 13.—Movement of flexion and extension of the prothesis, where the active flexion of the hand may be seen in any position. (While "posing," the patient closed his hand, and bent it.)

since it is placed in $C'D'$. This contrivance did not prove to have advantages over the previous apparatus, since angulation of the external tractor rendered the motor power useless and the motor lost much potential energy.

Because these two possible solutions failed, we undertook a thorough study of the problem, and several months passed without reaching a solution.

From another viewpoint the problem may be stated as follows: If it is not possible to shorten the external tractor, why not lengthen the axis of the forearm and gain the difference by means of propulsion of the hand during forearm flexion? The idea was an attractive one and we believe it is new and original with us. Therefore we set about our task enthusiastically, and after various attempts we succeeded in constructing an apparatus as shown in Figure 10.

The principle on which the apparatus is made is based on the log line or slide valve which consists of two pieces of material which dovetail one into the other, and which slide one on the other. When the forearm is bent, the hand must move from the center of the bend of the elbow. In this way the difference in distance is overcome, the distances remaining the same from the center of the kineplastic motor, that is, the external tractor constantly exerts the same tension, and the motor is able to produce normal action without losing either in power or in distance traversed.

In other words, in moving the hand it adjusts itself by describing a circle the radius of which corresponds to that of the motor. Thus we see that the curve of the hand does not correspond to the natural or physiological one but is rather the curve of the center of the kineplastic motor.

In Figure 10 one may observe that the axis of the forearm which holds the hand, in bending, will carry the latter to the position M (it must really be in the place of the dotted line M'') for the circumference of the elbow corresponds to the curve AB, and in no way to the curve AA' which is that made by the hand with its axis corresponding to E, the center of the kineplastic motor.

In spite of the fact that according to the figure, the center of the motor O' does not correspond to the center E of the curve made by the hand, we must not forget that during the contraction of the motor, its center or eye O' is displaced toward E and occupies the same place.

The propulsion of the hand is given by the little rod $F\ A$ which is rigid and solid with the hand, and the sliding is effected with the appliance called the slide valve C.

Flexion of the forearm is effected normally with the biceps. It is worthy of mention that with the appliance adopted, the kineplastic motor does not alter its power or run and the apparatus is just as powerful whether in the extended position or in that of greatest flexion. The hand moves from or draws near the normal axis of the elbow and the relative distance is maintained permanently and works with the kineplastic motor and its external tractor; consequently, the bending of the fingers is constant and does not vary as to power and fulness.

The solution of the problem as done by Dr. Wildermuth (Figs. 11 and 12) cannot be improved upon as it preserves all the advantages of the kineplastic motor during flexion of the hand. It allows us to modify our old ideas regarding kineplastic surgery, ideas which we believed fundamental and stable, and it opens up a wide field in surgery in the construction of motors adjacent to or upon the folds of the articular surfaces—plastics which hitherto have been considered contra-indicated because of the serious difficulties encountered in placing suitable prostheses.

Figure 13 shows the patient with the prosthesis applied. It shows that the action of the motor is permanent and stable in any position of the forearm, whether bent or extended; its position in the bend of the elbow does not affect its run or efficiency; and if to this we add that its power is 15 kilograms over a run of 4 centimeters, I believe we are justified in stating that we have overcome

one of the gravest and most serious difficulties in kineplastic amputation, and that we have triumphed brilliantly.

Let us not forget that the length of the forearm segment was 9 centimeters, that is to say, the indispensable minimum for the placing of an ordinary prosthesis, and that the motor was constructed with the remaining muscular portions of this region (supinator and round pronator) and the results, both surgical and orthopedic, have crowned our hopes and patient labors with success.

Our patient, who suffered double amputation, can now perform the necessary acts of daily life: he feeds himself, does many other things necessary in his personal care, exercises himself freely, and not only has he resumed many of his usual habits, but also he has regained his manly spirit, his personality, and his sense of honor. He is quite a gentleman!

THE UTILIZATION OF THE RUBBER CATHETER IN INTESTINAL ANASTOMOSIS[1]

By EDMUND J. HORGAN, M.D., F.A.C.S., Washington

THE use of a mechanical device to keep open the lumen of the intestine following suture dates back to medieval times. Lanfranc, in the thirteenth century, advised the use of a "pipe of elder" for this purpose, and it is likely that his contemporaries, following his teaching, used it in many instances. Intestinal suture was only practiced in those days in cases of injury. No description of resection of the intestine, if performed, has been left on record. From the thirteenth century until Lembert, in 1826, described his method of suture, no progress was made in intestinal surgery and from his time until the introduction of the aseptic suture by Lister, the development of intestinal surgery remained for the pioneers of the antiseptic and aseptic era. Resection of the intestine with end-to-end anastomosis by suture was accomplished and described by Halsted and others. Since the introduction by Halsted in 1887 of his method of intestinal anastomosis there have been many modifications of his technique.

When it becomes necessary to resect the intestine for tumor, an inflammatory process, adhesions, stricture; gangrene due to obstruction, strangulation, thrombosis, or volvulus; or to repair incised, lacerated or perforated wounds; or to close a fistula, the resected intestine should be removed in such a way that the circulation will be preserved in the adjoining segments and the tissues traumatized to a minimum, preventing œdema, infection, gangrene and necrosis, and the anastomosis or repair should be made so that the edges are evenly inverted and approximated and held by suture in such a manner that, during the process of healing, there will be no obstruction in the lumen of the intestinal canal or leakage of gas or fluid through the suture line. All of these requirements cannot be met with in every case. The lumen of the intestine may be so narrowed, following anastomosis or repair, that obstruction may occur from œdema or angulation, and the distention ensuing may cause cutting or tearing out of sutures and may prove fatal by allowing bacteria, gas, or fluid to contaminate the peritoneum. To maintain the lumen in the bowel during the process of union, following suture cylinders of dried intestine, bone, wax and tallow; ferrules of metal; dried trachea and cardboard cylinders had been used and described. Senn in 1888 described several mechanical appliances. He advocated the use of decalcified bone-plates to keep the stoma open in side-to-side anastomosis. In 1891 Robinson described a method of circular enterorrhaphy over a rubber tube 3 to 6 inches in length to overcome this difficulty. Murphy recognized the need of a method of intestinal anastomosis which in addition to other measures of safety, would keep the lumen of the bowel open and allow the passage of gas and fluid through the anastomosis. By his genius he devised a mechanical button for intestinal anastomosis which he described in 1892. Through his teaching, the method was popularized and has had many advocates. The button approximates the proximal to the distal portion of the intestine and maintains an opening. The intestinal wall which is clamped in the button becomes necrosed, allowing the button to lie free in the lumen and pass onward in the fæcal current.

Robson, in 1893, described a decalcified bone bobbin having an adequate opening to prevent obstruction and around which an end-to-end

[1]Presented at fourth annual meeting of the Association of Resident and Ex-Resident Physicians of the Mayo Clinic, Rochester, Minnesota, May 29-30, 1922.

Fig. 1. Case 1052. Illustrating method of using catheter in intestinal anastomosis. Soft rubber catheter passing through abdominal wall, omentum, enterostomy in distal segment of ileum and annulus of anastomosis into proximal segment of intestine. *1*, Divided ileum, with closure of distal segment and ileosigmoidostomy made at a former operation elsewhere, as found upon exploration. *2*, Aseptic inversion and closure of cauterized edges of opening in sigmoid by modification of the Parker-Kerr technique. As curved forceps is withdrawn with blades slightly open, the tips of the blades are depressed, inverting the cauterized edges. *3*, Dilated proximal segment of ileum. Non-distended distal segment of ileum cut diagonally and slit opposite the mesentery to increase circumference of lumen. *4*, Purse-string suture applied and enterostomy being made with cautery by technique of Long.

anastomosis could be quickly made with two continuous sutures. From this date until 1900 no important mechanical device had been described until W. J. Mayo reported the use of a rubber tube three-fourths of an inch in diameter, which was passed upward through the anus beyond the proximal side of the suture line after resection of the sigmoid, in order to allow the escape of gas and fæces so as to prevent impaction and leakage. A year later Balfour reported a technique for anastomosis of the sigmoid and rectosigmoid in which he used a large rub-

ber tube, placed in such a way that it passed from the proximal segment of the sigmoid downward through the distal segment and outward through the anus, the anastomosis being made over the tube. After the first row of sutures has been completed, the tube is anchored by a suture. By traction on the anal end, the proximal side of the anastomosis is invaginated into the distal and the second row is then placed. Mummery, in 1910, described the use of Keith's glass tube in resection of the sigmoid to keep the lumen of the bowel open during the process of healing, and he also mentions the use of a rubber tube for the same purpose.

I wish to describe a method of using a catheter in intestinal anastomosis, which I have employed in a few cases, and which has proved to be of great value. After making an end-to-end anastomosis by suture, if there is a constriction of the lumen or angulation, which will later cause obstruction; or if there is an accumulation of fluid or marked distention of the proximal intestine from pre-operative obstruction, I make an enterostomy in the distal segment of the intestine, and pass a catheter (Eynard-Wishard Model—20 Fr.) having 6 to 8 lateral eyes, into the enterostomy opening, through the annulus of the anastomosis and into the proximal segment. I can best illustrate this by the following case:

Case No. 1052. Miss A. N. P., a secretary, single, age 27, presented herself for examination July 20, 1921, complaining of pain in both lower quadrants of her abdomen, headache, backache, and swelling of legs. Four years ago she had an "irritating" pain on the left side of her abdomen for which she was operated upon and the appendix removed. This did not relieve her. The pain remained as before. One year later she was operated upon again. At the second operation the ileum was divided and the proximal segment anastomosed to the sigmoid; the distal segment was closed. Since this operation she has suffered from gas, a dull pain in both lower quadrants of the abdomen and backache. Headache, which is frequent, has a relationship to the trouble in the abdomen. At times she has nausea and vomiting. Eating causes marked abdominal distress and fullness. "Knots" form on both sides of the abdomen. She is markedly constipated and it is necessary to take a laxative every night. Bowel movement from laxative or enema does not give much relief. Her feet, ankles, and legs swell. During the past six months she has lost 20 pounds.

Upon examination the abdominal wall was found to be relaxed. The colon which was filled with hard masses of fæces could be palpated and outlined from the cæcum to the sigmoid. Urinalysis showed an acid reaction, specific gravity 1.030, faint trace of albumin, indican, many epithelial cells, leucocytes, and bacteria. The leucocyte count was 9000. A diagnosis was made of impaction of the colon from analstasis, following a division of the ileum and ileosigmoidostomy at a former operation elsewhere.

Operation September 28, 1921. (Province Hospital, Case No. 116,982.) Upon exploration through a left rectus incision, the ileum was found to be divided about 6 inches from the ileocæcal valve. The proximal segment which was markedly distended was found to be anastomosed into the side of the sigmoid, the distal segment which was closed, was found to be small and collapsed. The colon was filled with hard fæcal masses. It was decided to cut off the ileosigmoidostomy and to re-establish the continuity of the ileum. Two clamps were placed along the anastomosis and the ileosigmoidostomy was cut off with a cautery between the clamps. The opening in the sigmoid was closed by using a modification of the Parker-Kerr technique. The closed end of the distal segment of the ileum, which was collapsed, was opened by cutting it obliquely, and a longitudinal slit one-half inch long was made opposite the mesentery to increase the circumference of the lumen. Continuity of the ileum was re-established by an end-to-end anastomosis. When the anastomosis was completed it was found that the annulus of the anastomosis was small, and that there was danger of an obstruction occurring at this place later. To prevent this an enterostomy was made in the distal segment of the ileum with a cautery, by the technique of Long, and into it a catheter (Eynard-Wishard Model—20 Fr.) having six lateral eyes was inserted and passed through the annulus of the anastomosis into the proximal segment of the ileum. The catheter was fastened into the intestinal wall by infolding with a suture. The open end of the catheter was passed through a small opening in the omentum, made by thrusting a blunt forceps through it. Through a stab wound in the abdominal wall, the catheter was withdrawn and tension made upon it until the intestine, with the omentum interposed, was pulled up to the parietal peritoneum. The bell end of the catheter was clamped during this procedure to prevent leakage.

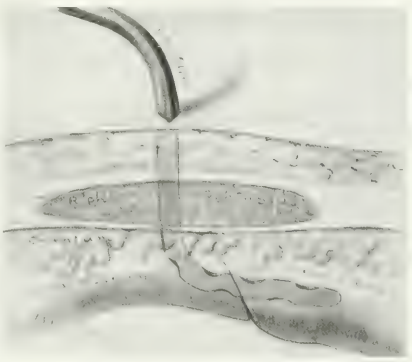


Fig. 2. Cross section of the abdominal wall showing soft rubber catheter in position. C. H. Mayo method of enterostomy employed. Catheter passing through stab-wound in abdominal wall, omentum, enterostomy opening in distal segment of ileum, annulus of anastomosis and into proximal ileum.

Postoperative convalescence. Twenty-four hours after the operation the clamp was removed from the catheter; gas and fluid escaped freely. About the fourth day the colon began to empty and the patient suffered considerably for 36 hours, while the hard fæcal masses were being expelled. After the colon emptied, drainage through the

catheter diminished. A clamp was kept on the catheter part of the time. On the seventh day drainage through the catheter had stopped and it was withdrawn. The enterostomy stab-wound through the right rectus muscle closed a few days later and convalescence continued without incident.

Charles H. Mayo and Victor Bonney have each called attention to the value of enterostomy as a life-saving measure in postoperative intestinal obstruction and paralytic ileus, and it is now a well-established surgical procedure in these conditions. In cases where I have anticipated intestinal obstruction, I have used a catheter in making an enterostomy at the time of operation as a precautionary measure, and I think it has been a factor in preventing postoperative obstruction. This practice of making an enterostomy as a measure of safety was the motive which prompted me to use it in the cases of intestinal anastomosis where I anticipated an obstruction. Without discussing the relative merits of making the enterostomy in anticipation of, or after the occurrence of obstruction, I wish to outline the value of the catheter in intestinal anastomosis.

1. It prevents obstruction from œdema, with closure of the lumen in the suture line, by keeping open the annulus of the anastomosis.

2. It acts as a drain, from the proximal to the distal segment, if there is angulation of the anastomosis or of the intestine within a few inches of the suture line.

3. It prevents distention by allowing escape of gas and drainage of fluid contents from the intestine.

4. It prevents peritonitis from the tearing out of sutures and separation of sutured edges by distention of intestine with gas and fluid.

5. Following resection for thrombosis or obstruction, the catheter, in addition to keeping the lumen of the intestinal canal open, will quickly drain off toxic substances which have accumulated.

In conclusion I would say that the advantage of this method of making an enterostomy in the distal segment of the intestine with a catheter, and the passage of the catheter through the annulus of the anastomosis into the proximal segment, offers a means of overcoming the dangers which lead to a fatal issue following suture of the intestine.

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A DEVICE FOR HÆMOSTASIS AND DRAINAGE FOLLOWING SUPRAPUBIC PROSTATECTOMY[1]

By JOHN H. CUNNINGHAM, M.D., F.A.C.S., Boston

HÆMORRHAGE, associated with suprapubic prostatectomy, originates from three sources: the prostatic capsule from which the gland is enucleated, the torn edges of the mucous membrane at the bladder outlet, and from the incision in the bladder wall.

A few operators believe that only the bleeding from the bladder wall incision requires attention, and are satisfied to disregard the bleeding from the prostatic capsule and torn edges of the bladder mucous membrane, simply controlling the bleeding from the bladder incision, by its closure by suture, about a suprapubic tube. Others, however, lay stress upon the bleeding from the torn edges of the bladder mucous membrane, incident to the enucleation of the gland, and advise careful suturing of these mucous membrane edges to prevent bleeding, which may occasionally be serious. Others feel that there is also real danger from hæmorrhage from the prostatic capsule, and for that reason either pack the prostatic region with gauze or employ a rubber bag, such as that of Hagner or Pilcher, for the purpose of arresting such hæmorrhage.

Personally the feeling is held that the source of the most dangerous hæmorrhage is from division of vessels in the incision of the bladder wall, not recognized and controlled by suture at the time of operation, yet hæmorrhage of a likewise serious character may arise from the free edges of the torn bladder mucous membrane, incident to the removal of the prostate, and that the ooze from the prostatic capsule is rarely of a serious nature, provided the enucleation has been properly carried out, and the prostatic capsule unruptured, and the vessels within it uninjured.

After a considerable experience in suprapubic prostatectomy without attention to hæmostasis, other than careful suture of the bladder-wall incision, I am convinced that in the majority of cases serious hæmorrhage is rarely an incident requiring attention; but, on the other hand, there have been many instances following such a procedure which cause worry, and in which a secondary operation to control hæmorrhage has been occasionally required. Particularly is this true of the smaller glands with much fibrous tissue, and those which extend upward under the trigone. Personally I have come to the conclusion that bleeding from all possible sources should be controlled as much as possible to conserve the patient's strength.

It being generally admitted that prostatic patients, as a class, are poor surgical risks, reasonable rapidity in operation and conservation of the patient's vitality in all ways, are important factors in lowering our mortality statistics. Lessening all bleeding incident to operation certainly is a factor to be taken into consideration in this connection, and I have come to the conclusion that bleeding from all sources should be controlled as thoroughly as possible.

My feeling in regard to suturing of the torn edges of the mucous membrane at the vesical outlet is that it is a procedure requiring an operation of increased magnitude, and is time consuming to the point of making it a questionable routine procedure on this account. Packing the prostatic region and compressing the torn edges of the mucous membrane by gauze, while not time-consuming, invites phosphatic deposit, in the presence of an alkaline urine, and its removal is a

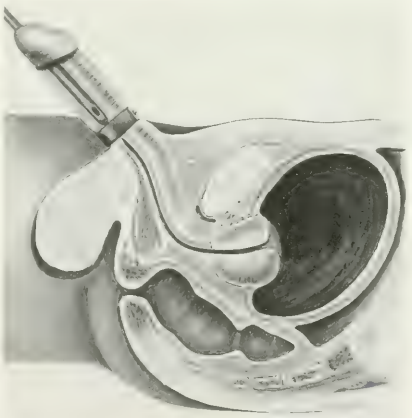

Fig. 1. Drawing showing bladder distended. The catheter following the bladder distention, withdrawn into penis; urethra compressed by a special clamp to retain the fluid in the bladder.

[1] Read before the New England Surgical Society, Burlington, Vermont, September 23, 1922.

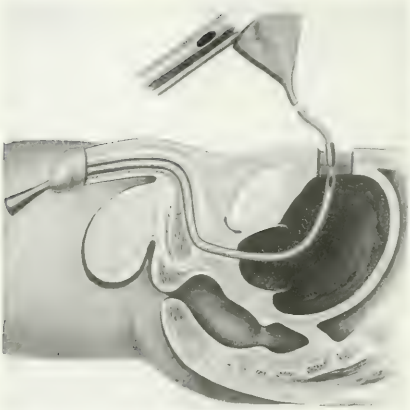

Fig. 2. Drawing showing the suprapubic cystotomy wound; the prostate removed; the free edges of the torn mucous membrane about the bladder outlet. The penile clamp has been removed; the catheter pushed into the bladder and out the suprapubic incision, the penile tube of the hæmostatic bag is attached to the catheter. By withdrawing the catheter through the urethra the bag is drawn into the prostatic region and the suprapubic drainage tube, attached to the inflating tube of the bag, is brought to a proper position and maintained without further adjustment.

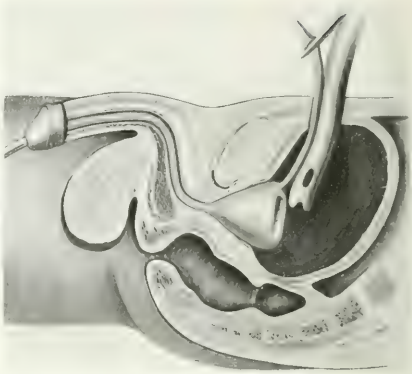

Fig. 3. Diagram showing hæmostatic bag located in the prostatic region, having been inflated by a syringe full of air, and the inflation tube compressed by a clamp. The torn edges of mucous membrane are compressed beside the bag, and cover the vesical sphincter. The bladder drainage is via the urethral tube, which passes through the bag, and by the suprapubic tube, which, being a part of the inflation tube naturally lies in such a position as not to rest on the bottom of the bladder.

painful procedure. The employment of a hæmostatic bag of the Hagner or Pilcher type, recommends itself chiefly because it is not time consuming, does control the ooze from the prostatic capsule, and by tucking the torn edges of the mucous membrane about the bladder outlet, over the bladder sphincter, so as to be compressed by the inflation of the bag, hæmorrhage from both these sources can be arrested, quickly and completely.

The only time-consuming feature aside from drawing the bag into position, following suprapubic prostatectomy, is the adjustment of the suprapubic drainage tube. To overcome this and facilitate the proper location of the drainage tube, and to provide for greater drainage through the penile tube of the Pilcher bag, I have had the bladder aperture of the penile drainage tube enlarged, and have had cemented to the "inflation tube" a suprapubic drainage tube, so that when the bag is drawn into the prostatic urethra, by withdrawing the penile tube down through the urethra, the suprapubic tube is made to occupy a proper position in the bladder. By employing this device bladder drainage is secured by means of the tube passing through the bag, and out through the urethra, and by a suprapubic tube placed in such a way as not to rest upon the bottom of the bladder.

This device, which we have used for several years, has proved, in our hands, to be the simplest and most satisfactory method of controlling postoperative bleeding following a suprapubic prostatectomy, is the least time consuming in execution, and has supplied the most satisfactory form of bladder drainage.

TECHNIQUE

The technique of employment, briefly stated, is to pass a catheter to the bladder, and after the bladder has been thoroughly irrigated, to distend it with fluid and withdraw the catheter into the penile portion of the urethra. If urine does not escape, because of the nature of the prostatic obstruction, suprapubic cystotomy is carried out. If, however, urine does escape, because the prostatic obstruction is not sufficient to hold all the bladder medium, a urethral clamp, that employed for incontinence,[1] is clamped onto the penis just beyond the end of the catheter (Fig. 1).

[illegible]

Suprapubic cystotomy and the enucleation of the gland is then carried out. The clamp, if used, is then removed and the catheter forced through the bladder and drawn out through the suprapubic wound. A metal cap, fixed to the penile tube of the bag, is fastened to the catheter by passing a small hook into the eye of the catheter (Fig. 2), or if the "cap" is not available the penile tube of the bag is sutured to the end of the catheter. The catheter is withdrawn, bringing the penile tube of the bag through the urethra, and drawing the prostatic bag with the suprapubic drainage tube into position. With the finger at the bladder outlet, the free edges of the mucous membrane are tucked down over the vesical sphincter; the bag inflated with air and the "inflation tube" clamped (Fig. 3). Thus the bleeding from the prostatic capsule, and that from the torn edges of the mucous membrane, is arrested by pressure. It then simply remains to control the divided vessels in the bladder wall by suture; about the suprapubic and "inflation tube," and close the external wound about these tubes and the drain to the prevesical space.

About 24 hours later the air is allowed to escape from the bag, which, however, is left in position. If bleeding becomes active, the bag may be reinflated, and if there is no increased bleeding in the succeeding 24 hours, the device is removed, and suprapubic drainage continued by the introduction of a large de Pezzer catheter through the suprapubic wound.

MODIFICATION OF RUBIN TECHNIQUE FOR TRANSUTERINE INFLATION OF FALLOPIAN TUBES

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THE Rubin technique for the transuterine inflation of the tubes has proven to be a very valuable procedure for the determination of the part played by the tubes in instances of sterility. By this means the patency or closure of the tubes can be ascertained without recourse to operation. For the purpose of this test the Rubin procedure requires a tank of oxygen or carbon dioxide gas, to which is attached a pressure reducing valve, and a flow volumeter to measure the quantity of gas introduced, a spring manometer for the estimation of the pressure with which the gas flows into the uterus, a Keyes-Ultzman cannula with a few extra holes bored near the distal end, and an ordinary rubber urethral tip slipped over this end and placed about 1.5 inches along the shaft, the necessary rubber tubing for making connections with these various parts, a tenaculum and a bivalve speculum.

The modification in this technique which I have used consists essentially in the substitution of a Janet Frank syringe for the tank of gas with its attached reducing valve and flow volumeter and the injection of air instead of oxygen or carbon dioxide. One may use any other suitable means for the introduction of air, such as a rubber bulb. The method of performing the test is as follows: with the patient in the dorsal position the bivalve speculum is introduced. The cervix and vagina are wiped dry with cotton and painted thoroughly with tincture of iodine. The cannula prepared as above is introduced into the cervix past the internal os. The urethral tip on the cannula pressed against the external os acts as an obturator and prevents the regurgitation of gas. A tenaculum for grasping and steadying the cervix is as a rule unnecessary, for it is usually easy to introduce the cannula without it, doing away with the pain attendant on its use, and slight pressure on the cannula, serves to hold the obturator firmly against the external os. The cannula is now connected by means of rubber tubing and a T tube connection, to a spring manometer on the one arm and a Janet Frank syringe with the plunger drawn out to its fullest extent on the other. Air is gently introduced through the cannula by pressure on the plunger of the syringe. The pressure exerted is recorded on the manometer. A pressure of 220 millimeters mercury is the maximum permitted, and if the air will not flow at that pressure maintained for a little while, the tubes are considered closed. In such cases retests are made one or two weeks later. The usual initial pressure varies from 60 to 120 millimeters mercury with a fall of pressure when the initial resistance is overcome and the air is flowing. It has been found that it is sufficient to introduce from 50 to 75 cubic centimeters of air. There is no immediate reaction. Varying from a few minutes to a half hour after the patient assumes the upright

position, there is a pain felt in the upper part of the abdomen and later in one or both shoulders, more commonly the right. This pain lasts with diminishing intensity for about 2 days, the duration depending upon the amount of air introduced, but at no time seriously inconveniencing the patient. No other reaction occurs.

This procedure has been used in 40 cases to date, with no evidence of any serious result, such as infection. Nor is there any reason to expect it, as the result of the introduction of air, since in every laparotomy air enters the peritoneal cavity with no untoward results. All the instruments used are of course sterilized.

The advantages in this modification of technique are obvious. It eliminates the necessity of having on hand cumbersome tanks of gas with their attachments. There is no possibility of the air being exhausted, as occasionally happens with a tank when a test is in progress. Being more compact the apparatus is readily portable should occasion arise. Furthermore there is no expense and inconvenience in the replacement of tanks. Air is free and always obtainable. The slight increase in the duration of the reaction can hardly be considered as a drawback, since it never amounts to a very great discomfort, and can be regulated by the amount of air introduced. This, as far as I can tell from the literature, is the first use of air for this test.

THE TREATMENT OF POSTOPERATIVE NAUSEA, VOMITING, AND DISTENTION IN CERTAIN ABDOMINAL SECTIONS BY THE USE OF A MODIFIED DUODENAL TUBE

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DURING recent years the use of the duodenal tube has become more general for diagnostic, investigative, and therapeutic purposes. Clinicians and research workers give varied reports as to its relative value. The apparently favorable results obtained in the hands of a few, because of its use as a therapeutic agent, has been responsible for the increased interest.

The immediate abatement of nausea and vomiting obtained after gastric lavage following an abdominal section has been noted, and in many clinics its use has become a portion of the regular routine. Frequent repetitions of the procedure are often necessary for the comfort of the patient.

Inhibition of peristalsis following the manipulation of the bowel during an operation may occur with the result that secretions, emptied into the lumen, lie dormant. Observation of the resulting nausea led me to determine the results of emptying the upper intestinal tract by means of a duodenal tube. The abatement of nausea and vomiting in every case was quite striking.

While at Bellevue Hospital, working under the direction of Drs. Warren Coleman and Max Einhorn, a study of the intestinal flora was made at different levels. This was made possible only by means of the use of a special coating for the Einhorn olive which I improvised and reported in the *Journal of the American Medical Association*.[1]

[illegible]

X-ray pictures were taken at various intervals, and proved that it was possible for the tube to pass through the entire intestinal tract. With this knowledge at hand I modified the duodenal tube (Fig. 1), by making numerous perforations, 2.5 centimeters apart, for a distance of 35 centimeters to permit the escape of gas and fluids from the intestinal tract traversed.

Ordinarily, the tube will be well into the duodenum and jejunum if passed 12 hours previously. If, perchance, some obstruction should prevent its ready passage, the surgeon can overcome this difficulty, and aid its downward progress into the duodenum and jejunum by direct manipulation.

Through the courtesy of Drs. A. J. Ochsner and N. M. Percy, of the Augustana Hospital, I have been able to observe the results obtained from its use in various types of intestinal and abdominal cases on their surgical services; the results have been gratifying.

The upper intestinal tract is very susceptible to toxins which are believed to be responsible for the occurrence of an acute dilatation of the stomach and, in some instances, hiccough. The use of the stomach tube gives immediate relief, but as it removes only the gastric and not the intestinal toxins, this relief may not be permanent. As absorption occurring from the small intestine is much more general and rapid than from the stomach, it is reasonable to expect that a con

tinuous gastro-intestinal lavage would be much more efficacious than simple gastric lavage. By this method elimination of toxins from the whole gastro-intestinal tract is made possible.

If vomiting is a physiological effort of the stomach to rid itself of its contents, a constant mechanical source of escape without the so often severe and painful retching should serve a good purpose and relieve the field of operation of unnecessary strain.

The nurse in charge is instructed to aspirate the contents every half hour for three hours following operation, then every hour or two as is indicated by the comfort of the patient. In many instances, it is better to leave the stop-cock open and allow continuous siphonage, thus establishing a constant source of elimination of gas and fluids.

In case aspiration is not carried out in a proper manner, there results a non-emptying of the contents, and the so often occurring nausea and vomiting becomes apparent. Later, aspiration results in immediate relief of the distressing condition. In several instances, the tube has been left *in situ* from 3 to 7 days with complete relief, but occasionally after its removal nausea occurred.

After each aspiration warm water is instilled through the tube and aspirated with an asepto syringe, and this is continued until the return is clear. The stop-cock can then be left open to allow further drainage and passage of gas.

For illustrative purposes, I cite two from several cases upon whom the tube has been used.

Case 1. E. L., female; age, 47; saleslady. One week previous a complete hysterectomy had been performed. Exploration revealed a gall bladder filled with stones, also a thickened appendix. Her condition did not warrant the removal of these at this time. The postoperative condition was stormy. She was very nauseated, vomited and was distended. After a few days she improved and one week later a second operation was performed.

The cholecystectomy was difficult and thus prolonged the operation; the appendix was also removed. A modified tube was passed the night previous. At the time of operation, it was found to be well in the duodenum and jejunum as desired. Aspiration was begun while patient was still upon the operating table.

Bile and other fluids were obtained. After the removal to her room, the aspiration was continued at intervals of one-half hour with the result that large quantities of bile and gas were removed, after which warm water was instilled. At no time was there any distention or vomiting. On the second day, the aspiration was delayed, and the patient became nauseated, but this disappeared immediately upon resuming the regular routine. The tube was accidentally pulled out on the third day, but there was no further nausea or vomiting, and the patient made an uneventful recovery.

Case 2. E. S., female; age, 55; housewife. Three years previous to admission patient had cholecystectomy for cholelithiasis. She felt well for some time, but again became ill with the same symptoms, which were chills followed by sweats, pain in the right upper quadrant radiating to the right shoulder, also slight jaundice and itchy skin. She came for consultation and later treatment. Diagnosis of stones in the common duct was made, and operation advised.

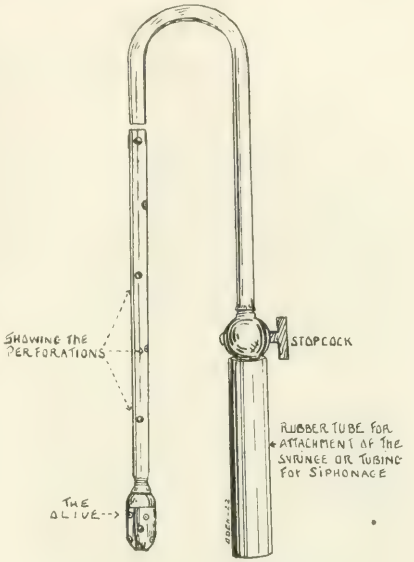


Fig. 1. Modified tube with perforations (in part).

Because of a stormy convalescence due to nausea and vomiting during previous operation, a modified tube was inserted the night before, and at operation was found to be well through the duodenum. The operation consisted in opening the common duct and removing several stones of varied sizes. The opening into the duodenum was nearly obliterated which necessitated the anastomosis of the common duct to the duodenum.

Aspiration was begun while patient was still in the operating room and continued at frequent intervals after removal to her bed. Later the stop-cock was left open and allowed to siphon. Lavage was made at intervals with 5 per cent sodium bicarbonate solution. The tube was left in place for 7 days. There was no vomiting or distention during this time, nor was there any drainage of bile at any time through the abdominal wound. Bile was not allowed to accumulate in the duodenum. She made a good recovery.

SUMMARY

The tube as described and used—

1. Relieves distention,
2. Prevents nausea,
3. Removes toxins,
4. Supplies fluids,
5. Can be used for instillation of therapeutic agents.

CORRESPONDENCE

RHINOPLASTY AND CHEEK, CHIN, AND LIP PLASTICS WITH TUBED, TEMPORAL PEDICLED FOREHEAD FLAPS

To the Editor: The undersigned authors of the article on "Rhinoplasty" which appeared in the January, 1923, issue of SURGERY, GYNECOLOGY AND OBSTETRICS through simple inadvertence in the attempt to cut down the length of their article, neglected to mention the source of some of the illustrations. These were taken from an article by Dr. Moure which appeared in the *Presse Médicale*, Paris, December, 1921, No. 103, p. 1021. The omission was unintentional and is deeply regretted by the undersigned.

CLARENCE A. MCWILLIAMS, M.D.
HENRY S. DUNNING, M.D.

New York

THE REGULATION OF CONCEPTION

To the Editor:

The Chicago Gynecological Society is desirous of giving proper publicity to its present stand on the subject of the regulation of conception. The following paragraphs are, therefore, submitted for publication:

In accordance with a resolution passed by the Chicago Gynecological Society the undersigned committee sent to all of the members of the Society a questionnaire dealing with various phases of the general subject of regulation of conception. The replies were analyzed and submitted to the Society at its regular business meeting of January 19, and the Society unanimously approved of the following conclusions:

1. It is against public policy that information as to contraceptives should be given to the general public.
2. Information as to the prevention of conception should be given, wherever indicated, to wives and husbands by physicians, either privately or in existing clinics and dispensaries.
3. Special clinics for the dissemination of this information are neither necessary, nor desirable, nor should nursing organizations be utilized to give out such instructions.
4. Risk to the mother, based on ill health, whether due directly to existing disease, or to the drain of too frequent childbirth under unfavorable home conditions is the essential indication for instruction in prevention of conception.
5. All mechanical devices used by the wife as well as strong chemical douches are discountenanced.

Respectfully submitted,

RUDOLPH W. HOLMES.
JOSEPH L. BAER.
N. SPROAT HEANEY.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
ALLEN B. KANAVEL, M.D. ..... Associate Editor

APRIL, 1923

BONE METASTASIS

IN cancer, bone metastasis is much more common than was hitherto believed. Schmorl of Dresden found that no less than 34 per cent of all cases of cancer coming to autopsy exhibited metastasis in bone. He published his observations in 1908. In the cases investigated by Schmorl post mortem, the secondary bone deposits were not always discovered until the medulla of the bones was opened up or after microscopic examination had been made. He concludes that the medulla of bone provides material which is particularly suitable for the growth of cancer cells. He makes the further interesting observation that secondary cancer may be found in the ossifying cartilages of the larynx and in the heterogeneous bone formation in aorta, glands, and in the tracheal and bronchial cartilages. Cancer cells, according to this authority, produce an incentive to the growth of bone, and he suggests a direct relationship between the secondary cancer deposit and heterogeneous bone formation.

Experience shows that metastatic tumors in bone may be present without being suspected by either the patient or the medical attendant: in many instances their existence has only been discovered accidentally. The complaint of pain in various parts of the skeleton, particularly in the spine, in patients suffering from cancer, should arouse suspicion: an investigation by the X-ray may demonstrate the presence of secondary growth in such cases. On the other hand metastases may lead to deformity in the spine or fracture of a long bone. In some instances extensive bone destruction may occur as, for example, in one instance where fully one-fourth of the tibia near its middle was completely destroyed by cancer growth secondary to uterine carcinoma. The cranial diploe is not an unusual site for such metastatic growths and these deposits in the diploe may be multiple. In fact the possibility of multiple deposits in all parts of the skeleton is a very remarkable circumstance. The writer has one case of breast cancer with X-ray evidence of secondary deposit in nearly every long bone of the body and in the cranium.

It would appear that the metastatic growth in bone is often latent and may remain of limited size for months or even years. The growth is for long periods confined within the bone, and there is little tendency to an invasion of the soft parts. In time, however, the soft parts may become invaded, and this is usually accompanied by increased rapidity of growth. There is evidence too that their growth is influenced by X-ray and possibly therefore by radium. One has found that pain due to such secondary deposits may be relieved very greatly by X-ray treatment. When fracture of a long bone occurs at the seat of a metastatic growth, union may occur after

suitable splinting: new bone formation occurs and the continuity of the bone is restored. At times, however, the extent of bone destruction renders union impossible.

Rokitansky in 1846 describes conditions which he believes to be "primary" cancer in bone: his error was explained either by assuming that he confused cancer with sarcoma or by failing to locate the primary growth elsewhere in the body of which the tumor in the bone was a secondary manifestation. He speaks also of "secondary cancer" in bone, but here too the reference he makes is not to metastatic formation but to direct extension, of the primary growth, into a neighboring bone. Thus the instances he gives are of invasion of the ribs and sternum in mammary cancer: the invasion of the skull from a primary growth situated in the dura mater of the brain and the occasional invasion of the bones of the pelvis from cancer of the uterus.

Possibly the first recorded case in which secondary cancer in bone was recognized in its true relationship to the primary growth was that recorded by Sir Henry Thompson in 1854.[1] This was a case of cancer of the prostate with secondary deposit in the lumbar spine. It is of interest to note that "Mr. Henry Thompson" was 31 years of age at the time, and the autopsy report, which is published in detail, and dated 21st of March, 1851, was signed by "Mr. Johnathan Hutchison" who was 23 years of age. Thus these two young men, who subsequently became famous in surgery, had been working together and thus early in their career had established an important fact regarding the manifestations of cancer.

Von Recklinghausen made a careful study of cancer growth in bone in 1891. Since that period the true significance of cancer development in bone has been better understood. Bone, as we have stated, may be invaded by direct spread from the primary growth, e.g. involvement of the ribs and sternum from breast cancer. According to Sampson Handley the secondary deposits in more distant bones (humerus, spine, etc.) may be caused by direct extension through lymphatic channels: one of his arguments in this connection is the immunity of the bones below the elbow and below the knee: such cases being too distant for lymphatic connection. On the other hand he traces lymphatics to the deltoid insertion of the humerus, and to the great trochanter of the femur as the most likely points of entrance for these bones. Schmorl and many others consider the pathway to be by the blood stream.

Secondary cancer deposits in different parts of the skeleton have frequently been encountered in cancer of the breast, prostate, uterus, etc., but in addition we have examples of other metastatic growths in bone. Of these perhaps the most frequent is hypernephroma of which many instances have been recorded. These have been most commonly found in the long bones but have also been described in the cranium and the sternum.

A. PRIMROSE.

[1] Tr. Path. Soc., 1851, v, 224.

A STANDARDIZED OPERATION FOR THE EXTRACTION OF CATARACT

THE statement is frequently made that when many different operations are devised, all having the same purpose, none of them is quite satisfactory. The truth of this statement cannot be denied but its application must be qualified if such operations are to be done in cases that present variations in conditions to be met. When a surgeon has once mastered the technique of one method of cataract extraction so that his

results are fairly uniform and satisfactory, is he justified in attempting to extract a cataract by any other method? That has been a puzzling question to most ophthalmic surgeons and has led to considerable discussion by exponents of a uniform method of operation. Are the end-results, when judged by a given standard, enough better to justify one in doing all cataracts by that one method?

Just when it can be said that one has mastered the technique of an operation is rather difficult to say. Yet almost every operator has his favorite method. Whether based upon his teaching, his experience, or upon theory, this operation will be the operation of choice and applied so far as can be in every case. It is quite generally conceded that the factors giving rise to different methods of extraction are the age of the patient, the type of cataract, the maturity of the cataract, and miscellaneous factors such as the general physical condition of the patient, restlessness, previous eye disease, and the usefulness of the second eye.

The importance of all of these factors is brought out in any extended discussion of cataract operations, and has widely influenced the practice of certain methods of preparation of the patient for operation, probably with the thought that it is easier to prepare a patient for a certain method of operation than to change the method of operation to suit the particular case presented. Comparative series of cases operated upon by different methods give a false index of the value of any operation at the hands of any operator, and have no logical basis unless it becomes imperative that some one method shall be adopted for all cases.

There is no uniformity in the types of cataract any surgeon will have to operate upon. The circumstances under which the operations are to be done cannot be made uniform, much less ideal. The limits of safety beyond which one must not go are determined by factors not entirely under the control of the operator and that method must be used and that risk taken which will be compatible with the best results. Every surgeon who attempts the extraction of cataract should be familiar with the technique of a number of operations and have at hand the necessary equipment to do any one of them. The method of operation should be determined by the conditions surrounding the cataract and not by the inclination of the operator. No one is justified in operating upon all types of cataracts under all circumstances by any one method.

W. L. Benedict.

MASTER SURGEONS OF AMERICA

CHARLES THEODORE PARKES

DURING the years immediately following the beginning of antiseptic surgery, a group of young surgeons appeared in America with quite unusual qualifications—men with boundless energy, unflinching perseverence, absolute honesty of purpose, clearness of judgment, exalted enthusiasm, and an intense desire to advance to the highest surgical excellence.

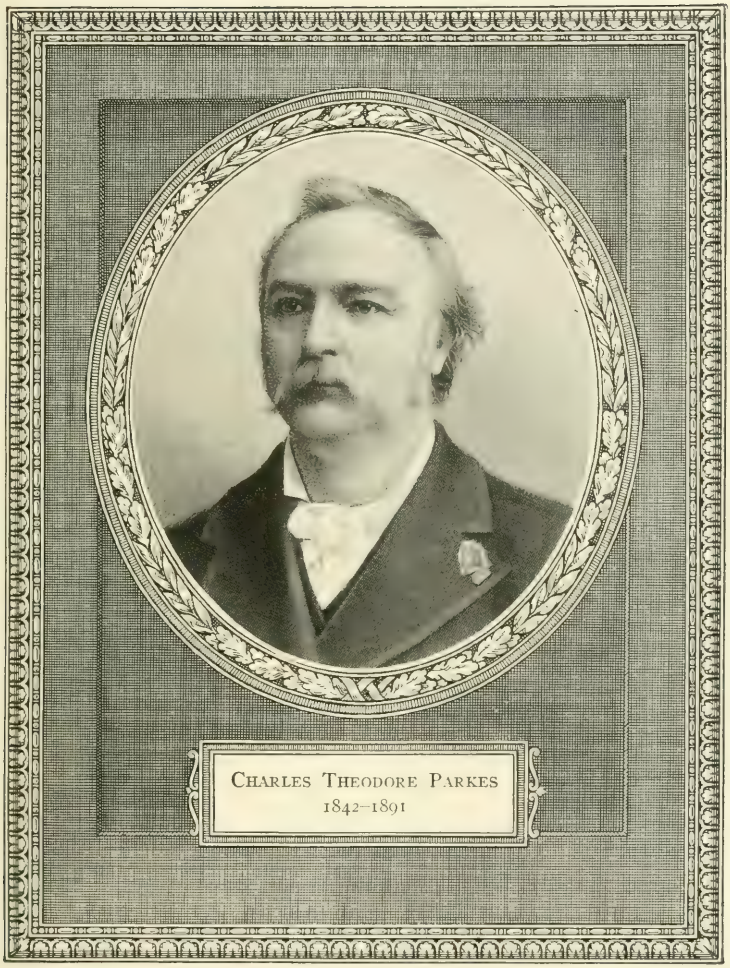
Many of these surgeons were splendid anatomists and excellent practitioners of general medicine, but had not enjoyed the benefits of a university education. In many cases, however, the student had engaged in teaching public school, or had broadened his mind by contact with men of ability during service in the army in our Civil War.

These men were hardy and clear-headed, unafraid of hardships or hard work. What they lacked in scientific training they made up in character and personality, and in those individual characteristics which enable men to accomplish unusual ends, and to leave a lasting impression upon their fellow workers and upon their community.

The most brilliant and withal the most lovable and attractive, and in his personality the most distinguished of all the surgeons of this group, was Dr. Charles T. Parkes of Chicago. Physically large and powerful, he was able to perform an unbelievable amount of work. Mentally a giant, he was able to grasp the surgical problems of his day with a clearness and precision which have rarely been equalled among the many great surgeons whose work I have been privileged to observe. His success depended primarily upon natural ability, personality, industry, and perseverence, but his environment and education aided greatly in bringing about such unusual results.

For generations his father's people were iron-workers in Stratfordshire, England. His mother's family had migrated to England from Brittany. His parents came to America in the late twenties of the past century. His father engaged in the production of iron, becoming half owner of one of the largest iron works in the west, located at St. Louis, Missouri.

During these years young Parkes enjoyed educational advantages in private and public schools, interrupted attendance at high school and 2 years at Ann Arbor University. The panic in the late fifties swept away his father's fortune,



CHARLES THEODORE PARKES
1842–1891

and this and the beginning of the Civil War interrupted his education. He taught school before joining the Union army at the age of twenty. He entered service as an enlisted man, and during his 3 years' service he became the most skillful drillmaster in the 117th Illinois Volunteer Infantry. While holding a captain's commission, he was given an independent command at Island No. 10 in the Mississippi River. He received mention in the War Department Records for an act of heroism.

Immediately following his discharge from the army, he entered Rush Medical College becoming the special student of the professor of anatomy. No doubt his army experience gave Parkes a willingness and an ability to do the enormous amount of work involved in carrying his studies, while doing the work of assistant to the chair of anatomy and acting as prosector.

Shortly after his graduation in 1868, he was made demonstrator of anatomy, which position he held until 1875, when he was elected to the chair of anatomy in Rush Medical College. This position he filled with distinction until the year 1887, when upon the death of Professor Moses Gunn, he was elected to occupy the chair of principles and practice of surgery and clinical surgery in his Alma Mater.

Shortly after his graduation, he received the appointment of surgeon to the North Chicago Rolling Mills, attending surgeon to Cook County Hospital, attending surgeon and later surgeon-in-chief of St. Joseph's and Augustana Hospitals, and attending surgeon to the Presbyterian Hospital. Dr. Parkes studied in London, Edinburgh, and Paris during the year 1878, and visited the surgical clinics of Germany during the summer of 1888 and 1890.

Dr. Parkes possessed great physical and moral courage. A story of his army life shows this side of his character. During an engagement, while within easy range of the enemy, it became necessary to signal to a re-enforcing division. In order to be seen, he mounted a fence in view of the enemy and gave his signal with a flag. Immediately a volley aimed by the enemy shattered the fence, fortunately leaving him unharmed on the ground. The flag, with its shattered staff, is in the State Museum at Springfield.

The following story is told to illustrate his enormous physical strength. In demonstrating anatomy, he was constantly annoyed by a large fellow, who persisted in crowding in ahead of the other students. When the patience of Dr. Parkes was exhausted, he picked the man up bodily, passed him over his head, and dropped him down behind him, to the great pleasure of the class.

Parkes received much inspiration from the remarkable men who composed the faculty of Rush Medical College from 1865 to 1890. Every man was a leader of men. They may not have ranked so high, in a cultural sense, as some professors in eastern medical schools, but they were enthusiastic teachers, who made teaching their first responsibility. Among these men were Moses Gunn,

J. Adams Allen, William Byford, Robert L. Rae, Henry Lyman, Edward Holmes, Delaskie Miller, Joseph Ross, J. W. Freer, and later Norman Bridge, James Nevius Hyde, and the best teacher and most charming gentleman of all, Walter Haines.

With these remarkable men he worked with wonderful enthusiasm, first as student and assistant, and later as the most distinguished colleague. His lectures and clinics were perfectly prepared, without regard to what it cost in fatigue or sacrifice, in consultation or practice. His college work was always his first responsibility. It was this which cost him his life. He was taken with influenza, but would not remain at home on his clinic day, although he was strongly urged to do this. During this clinic he had his fatal chill.

Parkes was one of the first surgeons west of Boston, New York, and Philadelphia, who performed many abdominal operations during the years 1880 to 1890. His diagnostic ability was so great that he acquired a national reputation which brought difficult cases to his clinic from many states. His absolute mastery of anatomy, with his years of practice in the dissecting room, gave him a command of surgical technique which I have rarely seen equalled and never excelled. His familiarity with every tissue enabled him to complete an extensive operation in an incredibly short time with an amount of traumatism so slight, when compared with that produced by other surgeons, that his patients came out of the anæsthetic with enormously less shock than similar patients operated on by other surgeons. They consumed much less ether, were exposed a shorter time to the possibility of infecton, and their wounds were in a much better condition for primary union because the tissues had not been unduly traumatized. He emphasized the importance of tying sutures so as to secure exact co-aptation, but never strangulation of tissues. His wounds healed regularly by primary union quite to the extent that such results are obtained in the very best clinics today.

With the exception of operations upon the eye, nose, and throat, he covered the entire field of surgery, excelling in general, abdominal, and gynecological surgery. His operations on bones and joints, and those for club feet, wry neck, cleft palate, hare-lip, and other deformities were quite remarkable and original. Here again his complete anatomical knowledge gave him an unusual advantage. He was, I believe, the first surgeon in this country to remove a stone from the pelvis of a kidney, and from the common bile duct, and one of the first to perform many gall-stone operations.

Parkes was one of the first surgeons in this country engaged in extensive original research and animal experimentation. His address "The Treatment of Gunshot Wounds of the Small Intestine as a Result of a Series of Experiments on Forty Dogs" presented before the American Medical Association in 1884, is a splendid piece of work, and his conclusions are still surgically correct. This was the most notable one of his many excellent papers. Of these, one on chole-

cystostomy, and one on choledochotomy, which operations he performed in 1885, amputation of arm, together with clavicle and scapula for sarcoma in 1889 with report of two cases, fifty successive cases of ovariotomy for removal of tumors, 1888, received international attention.

Parkes entered the field of surgery before Billroth, Volkmann, and Fenger had introduced pathologial training in the field of preparation for entrance into surgical practice; in fact before American medical colleges were equipped with pathological laboratories, but his surgical judgment was so excellent and his observations so acute and so extensive that this lack of training in a subject, upon which we now lay so much stress, did not seriously impair his surgical efficiency.

As a teacher, Parkes was the ideal of the medical student and the practitioner alike, because he gave them in a clear, concise way, exactly what they needed in their practice, not loaded down with a lot of irrelevant material. This is shown with great clearness in his clinical lectures which were taken down stenographically during the last year of his life, and published after his death. I have recently read these lectures again, and was amazed to see how much of the best of our present surgical practice they contained. Practically all of the younger surgeons of the middle and western states attended his enormous clinics at Rush Medical College, and followed his teaching in their practice. Thus he became the teacher of hundreds of progressive young surgeons.

Parkes died March 28, 1891, at the age of forty-eight, at the height of his success. He kept thoroughly abreast with all advancement in surgery of his day, and received recognition from all sides. Few men have had the personality, the industry, and the ability to accomplish so much as did Dr. Parkes in the few years of his too short life.

A. J. Ochsner.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held December 15, 1922, Dr. Henry F. Lewis, Presiding

POSTMATURE PREGNANCY

Dr. W. A. Newman Dorland: I would like to say a few words regarding a case presenting some unusual features.

The patient is a Jewish girl, 20 years of age, born in Turkestan, Asia, who gives a history of irregular menstruation. Puberty occurred at 13, but she missed one or two periods at frequent intervals. She menstruated last on December 12, 1921. In March, 1922, she complained of nausea and vomiting. About June 1, she felt fetal movements, and assuming that to be the middle of pregnancy she should have been confined about the end of October. Last week she visited the Lying-In Hospital and was told that she should have a cæsarean section done at once, to which she objected, and her physician brought her to my office. On examination I found the abdomen greatly distended and drum-like; the fetal heart 140, and strong fetal movements both to be seen and felt. The baby was lying on the right side in the second position, and the os was partially dilated. The head was very large. From the X-ray examination made at the other hospital it was thought that the baby probably had hydrocephalus, but the X-ray pictures made for me by Dr. Hubeny do not show this. I advised the patient to wait for another week, and then I would do a cæsarean section, which was agreed upon. She fell into labor at 1 o'clock yesterday morning and at 4 o'clock I performed a cæsarean section, delivering a living baby, weighing 10 pounds. Today I took the fetal measurements which showed the circumference of the head to be 36 centimeters, 14½ inches; biparietal diameter, 11½ centimeters; bitemporal 10½ centimeters; trachelo-pregmatic 14½ centimeters; occipitomental, 22 centimeters instead of 13½; frontomental, 9½; length of the fetus 20½ inches or over 50 centimeters; weight of the placenta 32½ ounces—2 pounds ½ ounce; giving her a large abdominal content and proving conclusively that she would not have been able to deliver herself. The X-ray pictures will show a baby, taken left and right, with the head lightly wedged in the false pelvis.

DISCUSSION

Dr. Rudolph W. Holmes: For many years I have consistently maintained that authenticated instances of prolongation of pregnancy were so infrequent that few physicians have seen such, that the reiterated reports of postmature pregnancies were figments of the imagination, based upon inexact data. We cannot doubt that true prolongation of pregnancy is possible. In substantiation of this I present the following case, the first, conclusive to my mind, in my experience. A woman menstruated December 12, 1921. January 20, 1922, she came to me. She had had nausea since January 11. The uterus was found not enlarged, but presented a suspicious softening. She felt life, April 17, i.e., 125 days after her last menstruation. Accordingly, she should have expected her baby about September 19. The baby was born October 28, 39 days after the expected and calculated time. The baby weighed 8 pounds, 11 ounces.

Dr. Charles B. Reed: I am glad to notice that some of the recalcitrant members are at last beginning to recognize the postmature child. The interesting thing about this subject is that if we measured the babies *in utero* oftener we would see more cases.

In Dr. Dorland's case the size of the head is out of proportion to the length of the baby. With a 50 centimeter baby we get a smaller head than that, and with a head of the size he reports, a much longer baby. The length of the child ordinarily corresponds to the size of the head which in this case is interesting as an exception. We have seen babies that weighted 10½ pounds that were 57 centimeters long, and this is not far from the proportion we would expect to get in a postmature baby.

Whatever the time spent by the babe *in utero* if it reaches so great a size it is postmature almost invariably. The men who do not see postmature babies are like the men who do not get perineal lacerations. They either do not look or do not know what to look for.

Dr. Dorland (closing): I noticed the disproportion between the length of the baby and the size of the head to which Dr. Reed referred, but I think it may be possibly explained in this way: the father was a small Jew, shorter than myself, who had a very large head. The mother was a woman a little under size but otherwise well built. The measurements of the head were carefully taken, and I know they are correct.

Dr. Lewis: What about the amniotic fluid?

Dr. Dorland: There was not an excessive amount of it.

UTERUS SEPTUS BICOLLIS

Dr. Carey Culbertson: The patient from whom this second specimen was taken is a young woman who entered the hospital complaining of pain in the lower abdomen, excessive uterine bleeding, leucorrhœa and such other symptoms as are classic in cases of general pelvic peritonitis based upon salpingitis. She had been well prior to 3 months ago save for an abortion, in the early weeks of pregnancy, 1 year ago, though from the history obtained there is some doubt as to the authenticity of the pregnancy. The first thing that attracted attention at the time of examination was a septum dividing the vagina mesially and longitudinally from the hymen to the vault and the presence of a cervix on either side of this septum. The uterus was upright, slightly enlarged, with its mobility reduced and its appendages prolapsed, thickened, tender, and fixed.

As the specimen shows, the uterus is a septate one with two cervices. The cavities are each 8.5 centimeters deep, the mucosa of the left one being not grossly thickened while that of the right is definitely hyperplastic. In this connection it is interesting to note that at the time of operation there was a blood discharge from the left and a profuse leucorrhœa from the right side. The uterine wall is .5 centimeters in thickness while the septum is fully 1 centimeter through; in other words the septum is rather a double wall than a mere partition. This is the fourth septate uterus that I have seen in three and a half years and in all of them the septa has been like the one here demonstrated. An operation has been described for the resection of the septum and the conversion of the two uteri into one by the approximation of the remaining two lateral portions. I have attempted such a procedure in but one of my cases. While feasible, the operation is not fully satisfactory because the septum is so thick that a very small uterus, indeed, is created. I should not attempt this operation in a uterus where the cervix is double, fearing resultant cicatricial stricture in the cervical canal. The obstetrical advantage of such an operation is not evident. It is well known that these maldeveloped uteri do not stand pregnancy well, and I fail to see in what way resection of the septum would assist such a uterus in enduring the strain of gestation. The band of tissue hanging from the cervix represents the vaginal septum which was removed with the uterus. The tubes are thickened, closed, and clubbed, each 10 centimeters in length, showing the changes characteristic of chronic purulent salpingitis.

PURPURA HÆMORRHAGICA IN GESTATION

Dr. George Clark Mosher, Kansas City, Missouri (by invitation) read a paper entitled "Purpura Hæmorrhagica in Gestation." (See p. 502)

DISCUSSION

Dr. Joseph L. Baer: It has been a great pleasure to listen to Dr. Mosher on this rather unique subject. I want him to tell us, if he can, something more about the relation between these purpuras hæmorrhagica in pregnancy and the purpuras that I am sure many of us have seen occurring not infrequently in relation to the menstrual cycle. In the non-pregnant I have seen perhaps half a dozen such cases, one of which I have vividly in mind, which began in the second pregnancy, with a rather profuse hæmorrhage into the calf muscle in the latter part of the second pregnancy. After delivery she has continued at almost monthly intervals to present ecchymoses varying from the size of a dime to half the palm of the hand, quite painful, and just preceding the menstrual cycle. Associated with these spots there has been a diarrhœa, with intestinal peristalsis so active as to be quite painful. There has been no temperature elevation, and no recognizable alterations in the blood picture.

Other cases I recall presented less striking phenomena, being limited chiefly to the appearance of a few ecchymotic spots usually on the lower extremities, and again in connection with the menses In none of these cases was there any pelvic pathology.

Dr. Charles B. Reed: I have been much interested in Dr. Mosher's paper, particularly from the standpoint of etiology. Dr. Mosher wisely did not go into it, but there are certain people who rush into it where they have no business. Hitherto in the literature all discussion of the etiology has been quite divided as to whether bacteria, toxins, chemical changes or changes in metabolism only are to be blamed. It appears to me, the condition must be due to a change in metabolism of a toxic character for certain reasons. Primarily, some of the cases occur so suddenly, that bacteria cannot be considered. Thus in the cases reported by Bobriski, we find one of a girl of 12 years terrorized by an attempted rape and a boy of 10 terrorized by a fire. In both cases the purpura appeared within 12 hours and logically this would exclude the possibility of a bacterial origin.

We are told by physiologists that certain changes are necessary for the production of blood clots. We have, for instance, thrombokinase arising from certain cellular elements of the tissues. This joins with calcium to produce thrombin and the thrombin unites with fibrinogen to form fibrin. This is a complicated process, producing ultimately a clot. It is necessarily a chemical process brought about finally by changes in the body and not really by bacteria, although we know that toxins, like snake venom and leech extract will produce antithrombin. We find the injection of trypsin, pepsin, and peptone, and other products will, at any rate, inhibit blood clots. If this is the case, it seems very probable that the etiology of this condition will be found along the line of newly-formed elements as in an antithrombin. This is entirely theoretical, but it seems to me the condition is borne out by the fact that nearly all these cases occur in people who are reduced by disease, by the occurrence of sudden

shock or fright or in the presence of pregnancy, and a chemical or metabolic condition is certainly most plausible.

Dr. J. P. Greenhill: As the essayist has pointed out, not many cases of purpura hæmorrhagica, occurring during pregnancy, have been reported in the literature. On this account, I should like to report briefly two cases of which I have cognizance.

The first is a patient, 20 years old, who is now under observation at one of the dispensaries connected with the Chicago Lying-In Hospital. She is now in the fifth month of her second pregnancy. During the first pregnancy, which terminated 2 years ago, she had the simple type of purpura hæmorrhagica, which manifested itself at the beginning of the pregnancy and involved chiefly the mucous membrane of the nose and gums. However, there were petechiæ and ecchymoses on the extremities, the chest and abdomen. There were no symptoms other than these hæmorrhages. The patient went to term, delivered a normal baby spontaneously, and had no undue bleeding after the delivery. The purpura disappeared very soon after the child was born and did not return until the beginning of the present gestation. The most troublesome hæmorrhages are from the nose and gums. However, hæmorrhages on the extremities and trunk have readily occurred after very slight trauma, and in some instances without injury. The compression of the cuff of the blood pressure apparatus produces ecchymoses. Were it not for the occasional severe attacks of epistaxis and gingival bleeding, the patient would have no complaints. She is moderately anæmic; the hæmoglobin is 60 per cent; the white blood cells number 7,400, and the differential count is normal. The bleeding time is 3 minutes, and the coagulation time is 2 minutes. The stained blood smear shows no abnormalities in the red blood cells or blood platelets.

On physical examination the only unusual findings are an enlarged, hard spleen and a very tender gall bladder. The Wassermann test is negative. No blood has been seen in the urine or stools.

During the last few weeks, upon the advice of Dr. Daly, who has been looking after the medical supervision of the patient, the latter has been taking calcium lactate in 10 grain doses, three times a day. There has been a definite improvement in the general health and a reduction in the number of hæmorrhages.

The second patient was one whom Dr. Rubovitz sent to the Chicago Lying-in Hospital last March. She was a primipara, aged $18\frac{1}{2}$, and was in her seventh month of pregnancy. Before admission she had had three severe attacks of epistaxis. On admission to the hospital she showed petechiæ in the conjunctiva, on the eyelids, and on the lower extremities. There was a systolic murmur at the apex of the heart, and this was transmitted upward and outward. Both the liver and spleen were definitely enlarged. The red blood cells numbered 3,100,000; the hæmoglobin was 35 per cent, and there were 30,000 white blood cells. The differential count showed 80 per cent large mononuclears, 8 per cent small mononuclears, and 12 per cent neutrophiles. There were no abnormalities in the red cells. In this patient, therefore, the etiology of the purpura was an acute lymphatic leucæmia. A transfusion was performed, using 500 cubic centimeters of blood from a pregnant woman, but the patient rapidly grew worse and died. Permission for an autopsy could not be obtained. Of interest was the fact that at the undertaker's establishment, a portion of the fetus was found protuding from the vagina. The fetus was extracted and seemed to be apparently normal. It is conjectural whether the abdominal pains of which the patient complained during and after the transfusion were labor pains, or whether the fetus was expelled postmortem.

Dr. Mosher, Kansas City, Missouri (closing): I appreciate very much the courtesy the gentlemen have shown in the discussion of my paper. I feel it is only by discussion that we can clear up the etiology of purpura hæmorrhagica.

With reference to the question as to the tendency to bleed there is such a condition in purpura undoubtedly based on fact. John Phillips has shown in a number of cases in women who had a tendency to purpura or erythema nodosum a likelihood of superficial bleeding, either petechiæ or ecchymoses, more excessive at the time of menstruation, and there must be some relation between this type of bleeding and the purpura in pregnancy.

The authorities agree with Dr. Reed when he says that the etiology is not determined, but we believe that it is more or less a metabolic condition. So far as the laboratory examinations that have been made demonstrate any relation with infection it is simply coincident. We are not at present able to show any bacterial involvement. The uterus has been removed postmortem and there has been found no evidence of sepsis; and nothing to indicate a chemical change.

The so-called scorbutic purpura suggests that there is in a certain class of women a dyscrasia, a condition of reduced resistance, which predisposes them to purpura, and a woman thus reduced is more likely to become the victim of purpura than the average. The fact that transfusion has been followed by very satisfactory results in the cases where it has been given should prompt one who may come in contact with a case of purpura hæmorrhagica to resort to this method of treatment, at the first opportunity rather than to experiment with other therapeutic measures which are usually futile, the patient meantime becoming subject to increased danger which it may be later on impossible to relieve

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS ON SURGERY

IN this review we call attention to a group of books the themes of which are widely diverse while yet they look upon the science of medicine from porches of considerable magnitude.

The monograph by Father Burke entitled *Acute Cases in Moral Medicine*[1] is a valuable document. In convenient form is printed for the first time the official attitude of the Catholic Church toward such unhappy emergencies as abortion, embryotomy, premature labor and ectopic gestation. The decisions in these cases have been handed down at various times from 1883 to 1905. It is, therefore, authoritatively determined that wherever a living ovum would be destroyed, all interference is forbidden. This means that no devout adherent of the Church, no matter what his scientific training, can do an abortion in behalf of the mother even though such a mother is attainted by incurable disease like cancer, tuberculosis, or pernicious vomiting of pregnancy. He may not do embryotomy in behalf of the mother without violating ecclesiastical law unless the child be dead. He may not remove an ectopic gestation unless rupture has occurred. The various methods of administering baptismal rites in emergencies is also adequately described. C. B. REED.

IT is not a far cry from this work to the book by Dr. W. W. Keen entitled, *I Believe in God and in Evolution*.[2] The superficial upheavals of the social structure which are brought about by charlatans who try to gain kudos through attacks upon the body of our accepted scientific truths serve at least the purpose of making us examine again the evidence upon which those truths are founded.

Dr. Keen has made this re-examination with concision and concludes, in the words of his dedication which we gladly accept, "To all sincere seekers after truth; who revere the Bible as the word of God; who revere Nature as the work of God; who believe that rightly interpreted they must surely agree."

When the Scriptures and Science are compared intelligently and without prejudice their co-ordination is inevitable, as Dr. Keen has so graphically and so logically attested. C. B. REED.

THE facile and versatile pen of Dr. Keen is responsible also for a second mention in this more or less medical group. His *Papers and Addresses*[3] uttered on various public occasions in the past are now collected and issued in one volume. They cover necessarily the most diverse topics. To the members of the American College of Surgeons the description of the forms of graduation in Old World colleges and institutions will have a strong ceremonial interest while the essay on the "Medical School and the Public" will appeal to the lay as well as to the professional reader.

"Before and after Lister" reviews for the surgeon and medical historian a critical phase of our progress but from every standpoint the two papers on vivisection are most important.

In these days of vaccination and serum therapy small pox is almost unknown, typhoid is easily controlled and diphtheria no longer a menace, and yet these diseases and tetanus and many others would now be as prevalent and as deadly as of old if the antivivisectionists had succeeded, as they hoped, in reducing animal experimentation to the state of utter extinction in which it existed in the Egypt of the Pharaohs and the Europe of the Dark Ages. Dr. Keen's vindication of its high value and utility to the commonwealth is logical and complete. C. B. REED.

FROM the moral phase of obstetric interference, through the gradual blending and interimpregnation of religion and science, we come to the *History of Medicine* by Walter Libby.[4] In this book we have the story of the growth of medical science from the faint vestiges of the past to the uberous and efflorescent present; from the priest physicians of Egypt and Babylon, when science and religion were synonymous terms, down to the time when bacteriology divorced the theorist and empiricist entirely from medical science.

With his luminous exposition of medical growth the author weaves in a generous amount of biographical material concerning the great discoverers who have made that growth possible. C. B. REED.

WE next come by a perfectly natural process to the work of a man who had no knowledge of evolution, indeed, but hesitated not to discuss religion and medicine, art and science, in every phase in which they affect humanity. In fact the chief subject of Montaigne's meditations and writings is the philosophy of life.

[1] ACUTE CASES IN MORAL MEDICINE. By the Rev. Edward F. Burke, M.A., Ph.D. New York: The Macmillan Co., 1922.

[2] I BELIEVE IN GOD AND IN EVOLUTION. By W. W. Keen, M.D. Philadelphia and London: J. B. Lippincott Co., 1922.

[3] SELECTED PAPERS AND ADDRESSES. By W. W. Keen, M.D., LL.D. Philadelphia: George W. Jacobs & Co., 1923.

[4] THE HISTORY OF MEDICINE IN ITS SALIENT FEATURES. By Walter Libby, M.A., Ph.D. Boston and New York: Houghton Mifflin Co., 19[illegible].

Dr. Taylor's volume on *Montaigne and Medicine* we have abstracted for us, that portion of the great essayist's reflections which concern personal health and the art of medicine directly.

Probably a dozen similar books could be separated out in the same way on the diverse topics which Montaigne has thought upon and illuminated.

A large library of critics and commentators has grown up around the essays and other material which this eminent egotist and subjective expositor has left to us. It is doubtless true, as Hazlett says, in illustrating the protean interests of the philosopher, that the Montaigne of Bayle is a gentlemanly skeptic, the Montaigne of the Voltaireans is a scoffer, the Montaigne of Abbé Labordie is a Capuchin Friar and the Montaigne of Emerson is Mr. Emerson himself. Mr. Taylor, however, has been extremely conscientious in eliminating his own personality and presents us, in one handsome volume, with a lucid and consecutive anthology of Montaigne's views on contemporaneous, and therefore 16th century, medicine. Altogether it is a gracious work and graciously has Taylor accomplished it.

C. B. Reed.

THIS monograph[2] is a practical treatise dealing with the requisites of amputation stumps so that they can best be fitted with artificial limbs; with procedures for improving the utility of stumps; with explicit directions how to measure stumps for artificial limbs and with a complete discussion of the preparation and manufacture of temporary and permanent artificial limbs of various kinds for the upper and lower extremities.

The author does not intend the book to be a complete and encyclopedic work on the subject, such as was published in Germany in 1920 entitled "Ersatzglider und Arbeitshilfen," etc., compiled by 30 authors, but presents it as a record of the conclusions reached as the result of 6 years' personal experience in the treatment of amputation stumps at the Royal National Orthopedic and in various Red Cross hospitals and in the prescription and supervision of prostheses at Queen Mary's Convalescent Auxiliary Hospital at Rochampton. During this time the author had some 25,000 cases under his personal care. While as an adviser on artificial limbs to the Minister of Pensions he has had opportunities of inspecting the various prostheses submitted for approval. The author has tried to avoid making the work a mere compilation of limb-makers' catalogues but has deemed it important to publish the illustrations of the most useful prostheses supplied by various limb-makers, limiting the description to British practice with only a few references to methods used in other countries.

The author's experience and opportunities during the Great War qualify him as one of the leading authorities on the subject, and he has been permitted to publish the drawings and diagrams and other material belonging to the Ministry of Pensions and he presents this valuable data in his monograph. This consists of the war standardization of artificial limbs including specifications for various types in detail. A separate chapter at the end of the work gives full directions for making certalmid sockets. "Certalmid" is the name given to a material made of certus glue, muslin, and celluloid and is a combination, the result of experiments made in the Experimental Workshop of the Munitions Inventions Department of the Ministry of Munitions. Tests have shown that certalmid sockets weigh only half as much as those of the same strength made of willow wood and covered with rawhide.

The work is concise, clearly stated and excellently illustrated. It contains a wealth of most important and strictly up-to-date information in regard to artificial limbs. It should be in the hands of all those who have to perform amputations and all those who are responsible for supplying these patients with suitable artificial limbs.

David C. Straus.

"THE object of this work[3] is to afford theopportunity of acquiring rapidly a practical knowledge of 'regional anæsthesia' and to teach the reader how to use the method successfully." This has been accomplished. The work is a result of a very thorough knowledge of the literature on the subject and a personal experience with many thousand cases. The book is comprehensive, giving details for operations in all parts of the body. Chapter IV discusses in great detail the blocking of spinal nerves. This is especially valuable since it is particularly in this field that Labat has done the most valuable work, both research and clinical. Paravertebral, cervical block, brachial plexus block, dorsal block, lumbar block and other types are discussed. In Chapter IX one is especially interested in his discussion of splanchnic analgesia both at the anterior and the posterior roots, including both Koppis' and Labat's technique.

The material is presented very clearly. Each technical description is preceded by a practical presentation of the anatomy of the region, with special reference to nerve distribution. The illustrations in conjunction with these anatomical descriptions and those showing details of technique are excellent and materially aid the reader in grasping the subject. Most of these illustrations are merely more artistic reproductions of the illustrations which appeared in *L'Anesthésie Regionalé* by Pauchet, Sourdat, and Labat. The entire work is strictly modern in every way and should be in the hands of those desiring to practice regional anaesthesia.

David C. Straus.

[2] [illegible]
Philadelphia and London: W. B. Saunders Company, 1922.

AMERICAN COLLEGE OF SURGEONS

FURTHER ENDORSEMENT OF HOSPITAL STANDARDIZATION IN CANADA

FROM the time of its inception, the standardization program of the College has received hearty endorsement in Canada. Each succeeding year has witnessed a progressive increase in the number of Canadian hospitals meeting the minimum standard. At the close of the 1922 survey, out of 60 general hospitals in Canada having one hundred or more beds, 50, or 83.3 per cent, were found to meet the requirements of the College; of the 73 hospitals having from fifty to one hundred beds, 36, or 49.3 per cent, met the standard, and grouping together the 133 hospitals having over 50 beds, there were 86, or 64.6 per cent, on the approved list. This figure exceeds by 2.1 per cent the percentage of approved hospitals in the United States.

In 1921 the Canadian Medical Association officially went on record as endorsing the program of the College. In November, 1922, similar action was taken by two other organizations influential in hospitals and public health matters in Canada.

The Dominion Council of Health held a convention in Ottawa on November 30, 1922. This organization is composed of experts from the different provinces with the Deputy Minister of Health as Chairman. The following resolution was passed by this Council:

"WHEREAS the American College of Surgeons, composed of over six thousand of the leading surgeons of Canada and the United States, is international in character and in functions:

"AND WHEREAS this organization has initiated, developed and carried out an invaluable constructive program for the betterment of our hospitals; and Whereas this program has, even in so short a time, effected an enormous improvement in the professional services of our hospitals;

"BE IT RESOLVED that we, The Dominion Council of Health, meeting in Ottawa this 30th day of November, 1922, representing the different provinces of the Dominion, wish to give our endorsation and approval to this great life-saving movement, leading as it is to greater efficiency and the general improvement in hospital service, and further, we hope that this work will be continued until every hospital in Canada, regardless of its size, meets the requirements of the standardization of hospitals."

During the same month the Western Canada Hospital Association assembled in Winnipeg. Hospital standardization was one of the chief topics of discussion at this meeting. The following resolution, which is characteristic of the attitude of this organization, was passed by unanimous consent:

"WHEREAS the American College of Surgeons, composed of over six thousand of the leading surgeons of Canada and the United States, is international in character and in functions:

"AND WHEREAS this organization has initiated, developed, and carried out an invaluable constructive program for the betterment of our hospitals:

"AND WHEREAS this program has even in so short a space of time effected an enormous improvement in the professional services of our hospitals:

"BE IT RESOLVED that we, The Western Canada Hospital Association, assembled here in convention, representing the four Western Provinces of Canada, namely,—Manitoba, Saskatchewan, Alberta and British Columbia—again reiterate our very hearty endorsation of this great work and service, unparalleled in the history of hospitals and leading to such improved efficiency; and we hope that such work may be continued and carried on actively in the future as in the past, till every hospital in Canada, regardless of size or type, meets the requirements:

"AND FURTHER, BE IT RESOLVED that this Association, as well as each of its component units, pledge themselves to render all the assistance possible to those charged with the duty of carrying on such an important and excellent work."

NORTH AND SOUTH CAROLINA STATE SECTIONAL MEETING

THE sectional meeting for the states of North and South Carolina was held in Columbia, South Carolina, on February first and second, with headquarters at the Jefferson Hotel. The arrangements were in charge of a local committee with Dr. Julius H. Taylor as chairman. The hospital conference was conducted in the ballroom of the hotel at 2:00 o'clock on the first afternoon. There was a good attendance of hospital superintendents, those interested in hospital work, and Fellows of the College. The round table conference was conducted by Mr. Robert Jolly, superintendent of the Baptist Hospital, Houston, Texas. At the meeting of the Fellows an outline of the work of the College illustrated with lantern slides was given by the Associate Director. The public meeting was held in the Baptist church and was well attended. An address of welcome was delivered by the Governor of the state, and in addition to addresses by various representatives of the College, the following papers were presented:

Some Facts about Cancer. Carl V. Hamann, M.D., Professor of Applied Anatomy and Clinical Surgery, Western Reserve University School of Medicine, Cleveland, Ohio.

Experimental Medicine from a Surgical Standpoint. John Wesley Long, M.D., Emeritus Professor of Gynecology and Pediatrics, Medical College of Virginia, Greensboro, North Carolina.

History of Anæsthesia and Anæsthetics. Stuart McGuire, M.D., President and Professor of Surgery, Medical College of Virginia, Richmond, Virginia.

Better Hospitals. Rev. C. B. Moulinier, S.J., President, Catholic Hospital Association.

How You Can Aid Your Hospital? Mr. Robert Jolly, Superintendent, Baptist Hospital, Houston, Texas.

On the second day, beginning at 9 o'clock in the morning, with an intermission for lunch, the following scientific papers were read:

The Treatment of Certain Types of Goiter. Stuart McGuire, M.D., Richmond, Virginia.

Intestinal Obstruction. Carl Hamann, M.D., Cleveland, Ohio.

The Value of Enterostomy in Intestinal Obstructions. John Wesley Long, M.D., Greensboro, North Carolina.

Acute Intestinal Obstruction. J. E. Stokes, M.D., Salisbury, North Carolina.

Case Reports on Intestinal Obstruction. J. R. Young, M.D., Anderson, South Carolina.

Occlusion of Mesenteric Vessels. J. W. Tankersley, M.D., Greensboro, North Carolina.

Intestinal Obstruction. J. F. Highsmith, M.D., Fayetteville, North Carolina.

Multiple Diverticula of the Jejunum with Case Report. E. S. Boice, M.D., Rocky Mount, North Carolina.

The Young Doctor's Opportunity and Our Duty to Surgeons and Citizens. Henry W. DeSaussure, M.D., Charleston, South Carolina.

Gastric and Duodenal Ulcer. Nunn D. Batting, M.D., Durham, North Carolina.

Corrective Surgery of the Foot. W. F. Cole, M.D., Greensboro, North Carolina.

A Few Excursions into Pulmonary Surgery. W. P. Herbert, M.D., Asheville, North Carolina.

Injury of the Common Carotid Artery and Internal Jugular Vein, Ligation, with Recovery. C. S. Lawrence, M.D., Winston-Salem, North Carolina.

Ocular Evidence of Intracranial Lesions. H. H. Briggs, M.D., Asheville, North Carolina.

Postoperative Treatment of Prostatectomy. Charles A. Mobley, M.D., Orangeburg, South Carolina.

The Origin, Circulation, and Absorption of Cerebrospinal Fluid and Its Importance in Intracranial Injuries. Addison G. Brenizer, M.D., Charlotte, North Carolina.

Regional and Spinal Anæsthesia. C. W. Rakestraw, M.D., Chester, South Carolina.

Cancer, Its Origin and Treatment. Julian M. Baker, M.D., Tarboro, North Carolina.

The Cancer Problem. Samuel Orr Black, M.D., Spartanburg, South Carolina.

Left Subphrenic Abscess Communicating with Right Side of Pelvis. G. T. Taylor, M.D., Greenville, South Carolina.

There was a good attendance at all sessions and the Columbia meeting may well be reckoned as one of the most successful meetings held this year. A great deal of credit is due to the local committees for their efforts.

COLLEGE ACTIVITIES DURING FEBRUARY

A meeting of the local Fellows of the College interested in the erection of the Murphy Memorial building at headquarters was held in New York on February eighth, at 4:30 p.m., at the Waldorf-Astoria. There was a good attendance and arrangements were made to push the Murphy campaign vigorously as the time has almost arrived when the building operations must be begun. A short address illustrated with lantern slides was given by the Director General.

At 10:00 a.m. on February ninth a meeting of the executive committee of the Board of Regents was held at the Waldorf-Astoria, New York, at which much important business was transacted. Following this meeting the officials present were entertained at luncheon on board the S. S. Vandyck by Mr. Williams, local manager of the Lamport & Holt Line.

The hospital standardization work of the College for 1923 is well under way. At the present time there are five visitors in the field and three more will begin hospital rounds within a few weeks. It is the desire of the College this year to visit all general hospitals having a capacity of fifty or more beds. This will include revisiting the hospitals previously approved or otherwise

Fig. 5. Enucleation of lateral lobes, completed with finger, the tractor being carried downward.

Fig. 7. The middle lobe attached to the two lateral lobes, already freed, is being separated from the sphincter and vesical mucosa, and enucleated from behind forward.

Fig. 6. With tractor held vertically, beak directed downward, the lateral lobes having been freed, the mucous membrane in front of the middle lobe is being divided transversely with scalpel. Ejaculatory ducts covered by index finger, which pushes them backward.

Fig. 8. The tractor has been removed and the index finger of the left hand introduced through the vesical orifice into the bladder to investigate the median portion. The subtrigonal lobule has been discovered, and is being separated from the sphincter.

SURGERY, GYNECOLOGY AND OBSTETRICS

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PROSTATECTOMY—PRE-OPERATIVE, OPERATIVE, AND POSTOPERATIVE TREATMENT[1]

BY HUGH HAMPTON YOUNG, M.D., F.A.C.S., BALTIMORE

From the James Buchanan Brady Urological Institute, Johns Hopkins Hospital, Baltimore, Maryland

PRE-OPERATIVE TREATMENT

IT is in the pre-operative treatment that most has been accomplished in reducing the mortality of prostatectomy and making the operation safe and practical for all cases. The one most important thing in the form of treatment is preliminary drainage. My attention was first called to the marvelous effects of drainage in a case of prostatic hypertrophy that was admitted to the Johns Hopkins Hospital in 1898 with a hugely distended bladder and in deep uræmic coma. Catheterization was attempted without success, and suprapubic drainage was accordingly carried out, and I witnessed for the first time the amazing disappearance of coma and restoration to apparently normal condition as a result of drainage. One month later I carried out my first prostatectomy suprapubically, removing a huge prostate successfully. The patient had an excellent convalescence.[2] Following this case, whenever patients presented themselves with evidence of renal impairment and particularly if uræmia was present, drainage either by intermittent or continuous catheter or by suprapubic drainage was carried out with the result that several desperately ill patients were operated upon successfully after a period of from 4 to 6 weeks' preparatory treatment.

The next important step in preparatory treatment was the use of large quantities of water, and this point in technique was adopted as a result of the following case which I reported in the *Maryland Medical Journal* in 1898.

A boy with a large appendiceal abscess was operated on by Dr. Halsted, and on the following day grew rapidly weaker, "temperature rose to 105.8,° the pulse to 156, but there were no signs of general peritonitis, and the condition was one of general septicæmia. Being in charge of the case in the country and having the responsibility, I realized that drastic measures were necessary and decided to try the effect of venesection and transfusion to wash out the poison in the blood. . . . Accordingly at 7 p.m., using cocaine anæsthesia, I opened the right basilic vein and allowed the blood to flow out, but the blood pressure was very weak and we could obtain only about 2½ ounces. I then injected normal salt solution, 1300 cubic centimeters being inserted. During this procedure the pulse steadily improved, and at the end had fallen from 160 to 130, and the volume had become fairly strong. His temperature fell from 105.8° to 104°, and his general condition was much bettered.

"This improvement was very decided for an hour after the transfusion, the nausea ceased, and he slept for a short while, but very soon the pulse became more rapid, and at 3 a.m. was 146 and quite weak. The patient was restless and the temperature was 104°. It was very evident that while the transfusion had been very beneficial it had not been sufficient, although he had received 700 cubic centimeters subcutaneously and 1300 cubic centimeters intravenously. Preparations were then made for another transfusion and at 6:45 a.m. it was begun. Twenty-

[2] Tr. Virginia M. Soc., 1899.

[1] Read before the Clinical Congress of American College of Surgeons, Boston, October 23–26, 1922.

five hundred cubic centimeters of salt solution were introduced into the vein during a period of 1 hour and 25 minutes, and had the effect of completely washing out the blood infection. The temperature and pulse dropped to almost normal, and after that there was never any concern about the boy's welfare."

My conclusions were that this case demonstrated the wonderful possibilities of saline solutions, but that it was certain that a small amount would be utterly useless in many cases. The curative effect was probably due to the dilution of the poison, and its rapid elimination by the excretory organs, and I recommended the method in acute uræmia, eclampsia, coma, operative shock, etc. It may be noted that the patient received 700 cubic centimeters subcutaneously and 3800 cubic centimeters intravenously during a period of 14 hours. Thereafter I did not hesitate to use water in large amounts in all cases of impaired renal function or uræmia and sepsis.

One of the most striking examples of results of this method of treatment was that of the following:

A man, No. 144, aged 76, who was brought into the hospital in uræmic coma, Cheyne-Stokes respiration, and a distended bladder from which a catheter withdrew 580 cubic centimeters of residual urine of very foul character filled with pus, bacteria, albumin, and casts. This patient was treated by intermittent catheterization, blood letting, transfusions and infusions. He was bled twice, 75 and 400 cubic centimeters being removed and salt infusions were given beneath the breast and transfusions (1000 cubic centimeters in the veins) and repeated several times over a course of 3 to 4 days. In 2 days the patient, who was apparently moribund became conscious and was soon able to talk coherently. At the end of a week the uræmic symptoms were entirely gone, and after that the patient's improvement was steady so that at the end of 6 weeks operation was performed successfully to remove the prostatic obstruction and the patient lived several years afterward.

The results obtained in these 3 striking cases furnished the groundwork for the method of preparatory treatment which has since been carried out.

In 1902, after having tried suprapubic prostatectomy and the Bottini operation, both with unsatisfactory results and with fairly high mortality, I brought out my prostatic tractor and developed the operation of "conservative perineal prostatectomy" which, with slight modifications, has been followed up to the present time, and as it is just 20 years today since the first of these operations was performed, it has seemed a propitious time to present a very careful analytical study of the 1049 cases which I have personally operated upon, particularly in regard to the preparatory treatment which was used and the results which have been obtained.

For purpose of comparison it seems well to refer to the first analytical study of 145 cases which was published in vol. xiv of the *Johns Hopkins Hospital Reports* in 1906. The mortality then was 4.8 per cent. Forty-one had been put on preparatory treatment consisting of catheter drainage and forced water by mouth or infusion or occasional intravenous transfusion and by rectum. Of these 32 cases were treated by frequent intermittent catheterization two to four times a day, and 9 by continuous catheter drainage for periods of from one to four weeks. The functional improvement of the kidneys was determined by the increase in the elimination of urea and the specific gravity of the urine as well as by the general condition of the patient. I tried the phloridzin test of renal function and also the freezing point test, but found both unsatisfactory and of very little assistance in determining the improvement of the kidneys in these cases.

In 1909 following work by Abel, in which the selective action of the kidney in the elimination of phenolsulphonephthalein had been demonstrated, Rountree presented an experiment upon a dog before the Inter-Urban Surgical Society. After bringing one ureter out through the skin of the abdomen so that the urine could be separately studied, he injected the renal artery with chemicals to produce a nephritis. Subsequently an intramuscular injection of phenolsulphonephthalein was made. With a catheter in the bladder collecting the urine from the normal kidney and the other ureter draining externally, a comparison of the separated urine showed that the phenolsulphonephthalein was more abundantly secreted from the supposedly diseased kidney which had been injected with chemical irritants

TABLE I.—PHTHALEIN TESTS ON ADMISSION AND AGAIN BEFORE OPERATION IN SOME CASES

Phthalein test on admission	Phthalein test just before operation													
	Test not repeated	0–4	5–9	10–14	15–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89	90–99	Total
?						1	1	2	3	4	2		1	
0–1%				1		2				1				4
5–9%				1		2	1							4
10–14%	1			1	1	2	.	4	1				.	10
15–19%	1					2	1	1	1					6
20–29%	6					2	5	10	11	2			.	36
30–39%	15					1	7	14	20	9	4			70
40–49%	60					1	4	11	21	14	1			112
50–59%	95					2	1	6	20	18	5			147
60–69%	92							2	8	18	5			125
70–79%	16									1	1	1		19
80–89%	2										1	.		3
90–99%												1		1
Totals	283			3	1	15	20	50	85	67	19	2	1	.
Phthalein tests not repeated				1	1	6	15	60	95	92	16	2		
Total phthalein at operation				4	2	21	35	110	180	159	35	4	1	551
Percentage				.73	.35	3.8	6.3	20	32.3	28.8	6.3	.73	.18	

The deductions drawn from this case were that phenolsulphonephthalein was more abundantly secreted by a diseased kidney, and as I had in my wards a human case practically identical with that of the dog, in which one ureter was draining externally, I suggested that the test be tried upon this patient. The results obtained when finally analyzed showed that the drug was in realty eliminated in large quantity by the healthy kidney and not by the diseased as supposed. (Probably a hyperæmia had been produced and not a real nephritis by the injection into the renal artery.) During the course of the next few months our cases were subjected to the phenolsulphonephthalein test in my wards, and Geraghty and Rountree presented their splendid paper on this subject which standardized the test and has been corroborated by much research and hundreds of scientific papers throughout the world.

After this the drug was tried out in cases of prostatic hypertrophy, one of the first of which was one of my patients who was markedly uræmic and in which the drug showed great improvement from week to week as a result of continuous catheter drainage. Geraghty and Rountree stated in their paper as follows: "The application of this test has brought forward new evidence as to the marked improvement in the renal conditions which accrues as a result of the preliminary treatment introduced some years ago by Dr. Young. Many cases in our series, which on admission showed a very low output under this treatment, show a progressive increase in the amount eliminated. Two cases exhibiting only a trace died of uræmia. In neither case was an operation performed, though clinically at the time of the first test, no evidence of uræmia was detected. The test has made it possible to select a time for operation when the kidneys have regained their full functional power and stability."

Since 1909 when the phthalein test was first used, it has continued to be a routine method of study in all cases in the department of urology at the Johns Hopkins Hospital, and it seems desirable to present here a detailed analysis of my experience with the drug in cases of prostatic hypertrophy. In making this study I have taken advantage of the

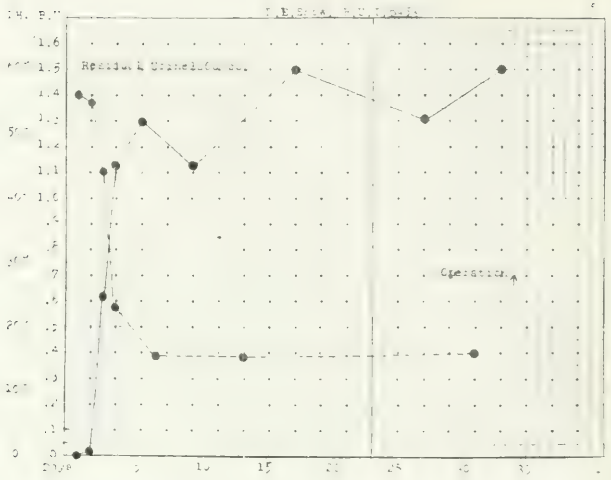

Fig. 1. Chart showing the improvement in the phthalein and the phthalein percentage and the reduction in blood urea as a result of catheter drainage and forced water treatment. There has been a very rapid improvement in this case.

splendid work of Dr. Raymond Pearl and his associates in the department of Biometry and Vital Statistics of the School of Hygiene, Johns Hopkins University. Miss Mary Gover, under the direction of Dr. Pearl, has prepared a most thorough analysis of one thousand cases of prostatic hypertrophy, using the punch card system which has been introduced by Dr. Pearl. Miss Gover's work, which has been most tedious and exhaustive, and has occupied her constantly for 2 years, furnishes endless material for clinical and analytical study in these one thousand cases of prostatic hypertrophy, and has been utilized very extensively in this paper. In the first place I wish to present a study of the phthalein test on admission and again before operation (where more than one test was made). As seen in Table I, Miss Gover has studied 551 cases in which the phthalein tests have been satisfactorily recorded.

The table speaks for itself so that little comment is necessary. Almost all patients with low phthalein on admission were given preliminary treatment consisting of continuous urethral catheter drainage and forced water by mouth or if necessary infusions subcutaneously. The improvement in the phthalein percentage is demonstrated by the figures which show that of those cases with phthalein on admission between 0 and 4 per cent, one, before being operated on, had reached the period between 10 and 14 per cent, two, 20 to 29 per cent, and one 60 to 69 per cent. Of the 16 cases between 10 and 19 per cent on admission, all but four were above 20 per cent at operation. As a matter of fact only 46 were operated upon before the phthalein had reached 30 per cent. One hundred and sixty-two patients (31 per cent) had less than 50 per cent phthalein, and 69 per cent of the cases had over 50 per cent phthalein at operation. About 90 per cent of the cases (all but 6 of the 551) improved so much in kidney function that the phthalein was 20 per cent or more at operation.

In 1913, following the work of Rountree and Geraghty, we began using blood urea estimations in cases with low phthalein tests.

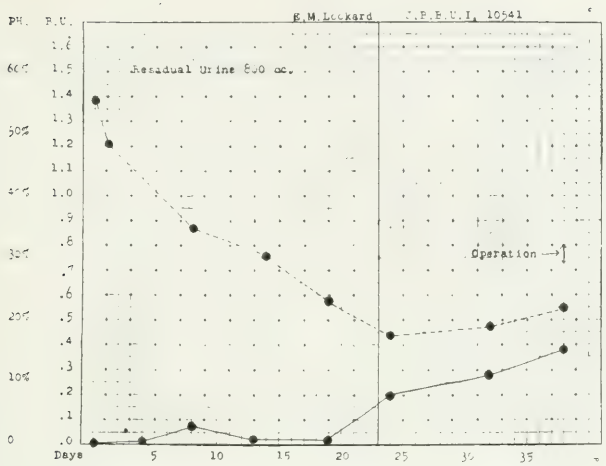

Fig. 2. Phthalein and blood urea. Chart showing much more gradual improvement. The blood urea dropped almost to normal before the phthalein improved at all.

TABLE II.—RESULTS OF CONTINUOUS CATHETER DRAINAGE IN CASES WITH LOW PHTHALEIN AND HIGH BLOOD UREA TESTS

Case number	Residual urine c.cm.	Retention complete	Phthalein test: On admission Ap. T. min.	Phthalein test: On admission Ph. % in 2 hrs.	Phthalein test: Before operation Ap. T. min.	Phthalein test: Before operation Ph. % in 2 hrs.	Blood Urea: On adm. Gms. per L.	Blood Urea: B. op. Gms. per L.	Prep. treat. days.	Oper. result cured
5839	2100		30	trace	25	10	1.40	0.26	28	C
5847	500		30	trace	20	25	1.20	0.76	47	C
7155	1000			trace		60	1.40	0.40	56	C
6281			30	trace		50	1.05	0.41	26	C
8045		R.C.		trace	10	24	0.96	0.74	29	C
1352	1200			9		30	0.78	0.50	27	C
8018	800		10	15	18	28	0.80	0.36	98	C
1419	250		24	10	12	18	0.01	0.64	14	C

Table II gives the details in a group of 8 cases with very low phthaleins on admission. Most of these cases had never been catheterized and had a large residual urine and, in 5 cases with only a trace of phthalein, the appearance time could not be determined on account of the small quantity secreted, but in 4 cases it was much delayed. The blood urea was two to four times the normal, but under continuous catheter drainage it came down to normal (gram .30 to .50 per litre) or nearly so, and the phthalein rose considerably in most cases, the average length of treatment required being 39 days. Suprapubic drainage was not carried out in any of these cases.

In Case 8453, with 1000 cubic centimeters residual urine, the improvement was very rapid, as shown in Figure 1. The large residual, bad phthalein and blood urea tests, caused us to force water, so that he received 5000 cubic centimeters daily, and the high blood urea was literally washed away and was normal in a week. At the same time the phthalein rose to normal, and on the thirty-eighth day the patient went through operation successfully. In another case (10541), Figure 2, with 800 cubic centimeters residual urine, phthalein 0 and blood urea 1.38, the improvement curves were more gradual, and it was not until the thirty-eighth day that the phthalein *reached 38 per cent* and the patient was considered a good operative risk.

The value of this plan of preparatory treatment which I have now used for many years is shown by the fact that there have been 8 cases with only a trace of phthalein, 4 with phthalein 5 to 9 per cent, and 12 with phthalein 1 to 14 per cent on admission with only one death, and that a patient (3412) who had only 12 per cent phthalein in 2 hours on ad-

mission and at the end of 9 days was operated upon regardless of the fact that his phthalein was only 13 per cent. How this slip could have occurred I know not. It is not surprising that he died of uræmia.

I will not attempt here to discuss the question of what the exact nature of the damage is which comes upon kidneys as a result of prostatic obstruction, but a study of Miss Gover's statistics shows that a patient who has a large amount of residual urine has generally badly impaired kidneys, as shown by both renal and blood tests. For example, among 8 patients with phthalein between 0 and 9 per cent the residual varied from 450 to 2100 cubic centimeters in 5 cases, and none had been catheterized, two had led catheter lives for a few months, two for several years and one had a suprapubic urinary fistula. Under continuous drainage and huge quantities of water all improved sufficiently to go through operation successfully.

Among the 15 patients with phthaleins between 10 and 19 per cent only two had complete retention of urine and the highest residual was 830 cubic centimeters, but six were 500 cubic centimeters or more, and only one of these had ever used a catheter.

Among 31 cases, in which the admission phthalein was between 20 and 29 per cent, 6 had a residual above 500 cubic centimeters. One of these had a residual of 1250 cubic centimeters but he had catheterized himself occasionally and the phthalein was 27 per cent and rose after 32 days of preparatory treatment to 42 per cent. Four of the others with residuals of 500 to 700 cubic centimeters had likewise used a catheter once or twice a day, but one patient with 700 cubic centimeters residual urine had had symptoms of prostatic obstruction for 2 years and had never been catheterized—yet his phthalein was 20 per cent and rose in 16 days to 46 per cent when he was successfully operated upon.

The situation may be summarized as follows:

1. Renal impairment is proportional (roughly) to the back pressure in the ureters.

2. This is characterized by dilatation of ureter, pelvis and calyces and thinning of renal cortex.

3. It is most common and most pronounced with large residuals in patients never catheterized.

4. It is less pronounced in large residuals intermittently catheterized.

5. Marked impairment may occur with residual urine less than 400 cubic centimeters but not so frequently.

6. It occasionally occurs with small residuals (less than 100 cubic centimeters) probably due to frequent and prolonged urination during which the ureters are closed and pelvic distention occurs.

The presence of infection may greatly accelerate the renal lesion, and severe cystitis, especially if associated with vesical calculus, adds to the vesical spasm and consequent back pressure. The improvement which follows vesical drainage through a catheter is remarkable, and the rapid fall in retained urea in the blood, and the rise in output of phthalein by the kidneys is one of the most splendid of therapeutic results.

That there is some danger of suppression of urine from the sudden evacuation of a much distended bladder is undoubtedly true and it has been our practice in cases in which we found a residual of over 500 cubic centimeters to force water at once, if necessary by infusions or by rectum. If the phthalein is very low and the blood urea high, intravenous salt solution may be advisable. In such cases I have occasionally, during the past 10 years, elevated the drainage tube so that the bladder empties up hill, so as to maintain an intravesical pressure for a time. Whether this is better than partial emptying and intermittent catheterization I am not sure, for we have encountered some severe uræmias in these cases, which have required drastic treatment. We have lost some three or four cases, autopsy showing great thinning of the renal cortex.

The great bugaboo which has been raised in the literature, viz., post-catheterization hæmorrhage, occurs so seldom as to be almost negligible—but it does occur and apparently comes sometimes from the kidneys. I think catheter drainage is far safer than suprapubic cystostomy in these cases of large residual, because of the possibility of exerting some

counter pressure, or of keeping the bladder fairly filled if necessary. The most important procedure is to provide against suppression by putting the patient into a warm bed at once, and forcing water by mouth and infusion of salt solution. We try to give 5 or 6 litres of water during the first 24 hours and increase to 10 litres a day if signs of uræmia supervene (salt solution by rectum and intravenously, and venesection, if desperate). I have been unable to determine which of the diuretics was most helpful, but make use of several, while depending most on the water cure.

The amazing way in which patients in chronic uræmia with severe mental and gastric disturbance and general systemic breakdown, high blood urea, and no phthalein, may be carried through the post-catheterization crisis to a gradually improving renal function until prostatectomy can be safely done under gas anæsthesia, is one of the triumphs of modern medicine.

I have not the time to do justice to other clinical laboratory procedures such as nonprotein nitrogen, creatinin, carbon dioxide, nephritic diet tests, etc., etc. All of these have a value and are sometimes very helpful, but the phthalein test is certainly the most valuable in telling the clinician and surgeon the functional value of the kidneys, and, if low, a blood urea test will demonstrate any urea retention, which, if present, must be eliminated before operation is undertaken. The simplicity and accuracy of these two tests make them most satisfactory.

Early in my experience with the phthalein test in cases of prostatic hypertrophy, we discovered that no hard and fast standards, below which it would not be safe to operate, could be insisted on. A review of Miss Gover's tabulations shows 27 cases in which the phthalein was below 30 per cent at operation with 3 deaths, a mortality of about 11 per cent. These patients came 10 years ago, before we began insisting on blood ureas in all low phthaleins, and, by some strange mischance, were treated only 9, 13, and 18 days, respectively, before operation. Unquestionably more prolonged efforts to improve renal function, checked by blood ureas, should have been made.

There are cases in which it is impossible to get the phthalein as high as 30 per cent, but if a prolonged effort has been made, the blood urea is not over gram 0.50 per litre and symptoms of uræmia are absent and water will be tolerated in large quantities, I have found that such cases go through operation well. As shown in Table I, out of 551 cases, at operation all but 27 had a phthalein of over 30 per cent and only 35 between 30 and 39 per cent. The lower the phthalein at operation the higher the mortality. If possible the operator should wait until the test is over 30 or 40 per cent before carrying out prostatectomy.

INFECTION

Infection is responsible for a large number of the fatalities in prostatics. In early cases the patient comes in with a small or moderate amount of residual urine which is usually sterile. If a catheter has been used, cystitis is almost always present. In many cases it is mild—simply a bacilluria due to the colon bacillus; in others a moderate pyuria is present, and in more severe cases this is accompanied by a large amount of pus and often with other organisms present—staphlococci, rarely streptococci, and occasionally, if the urine is ammoniacal, the proteus bacillus.

When the infection has spread to the prostate and seminal vesicles it may produce an abscess, but usually only a chronic prostatitis and vesiculitis. If the infection reaches the kidneys, a pyelitis, or pyelonephritis may seriously complicate the case.

Infection is frequently present in cases that have not been catheterized, particularly if the residual is great. Almost all cases become infected after prostatectomy, and statistics seem to show that cases with a mild cystitis run a smoother postoperative course and are less subject to fever and toxæmia than the previously sterile cases. One of the most annoying complications is epididymitis, which occasionally follows instrumentation, especially frequent or continuous catheterization, before or after operation. In my statistics it occurs in about 20 per cent of the cases.

Although some urologists have held it desirable to have the bladder become infected before operation—to have the general and

tissue reactions established and over with before prostatectomy—the danger from a virulent organism, especially a coccus infection, is such that strict asepsis should be the rule in instrumentation and also at operation. Besides cleaning up the external genitalia the anterior urethra, which is the habitat of both bacilli and cocci, should be sterilized by injection—I use a 1 per cent meroxyl which is as germicidal as bichloride of mercury, works in the presence of albumin, pus, and urine, and is non-irritating.

CATHETER DRAINAGE

Catheter drainage need not be given to those cases with a good phthalein and slight residual urine (100 cubic centimeters, and occasionally more, in patients in prime condition). In such cases after perineal prostatectomy we irrigate the bladder with 1:1000 meroxyl, or other mild antiseptics, through the drainage tube several times before removal of the tube on the first or second day after operation. The urethra and wound are similarly irrigated to hold down infection and lessen the danger of epididymitis. The orderlies irrigate the wound externally at each change of the dressings. In a few cases we have succeeded in carrying a patient through the pre-operative treatment, operation and convalescence with sterile urine, but in almost all cases a bacillus coli infection occurs. Where the phthalein is below 50 per cent or the residual pronounced (say over 200 cubic centimeters) or the patient's condition such as to call for preparatory treatment, a rubber catheter, No. 18 or 20 F., is inserted for continuous drainage and the bladder irrigated twice daily with 1:1000 meroxyl, or 1:8000 acriflavine or 1:60,000 bichloride of mercury twice daily. Catheters are changed every 3 days with a 3 to 4 hours' interval between removal and reinsertion—during which time the urethra is also irrigated.

If catheter drainage is maintained a week or more, a bacillus coli infection generally occurs, regardless of the careful antiseptic technique. Cases already infected are usually improved by catheter drainage and irrigation twice daily, and severe cystitis should be vigorously treated before operation unless accompanied by calculus, in which case it is almost useless.

SUPRAPUBIC DRAINAGE

Suprapubic drainage may be required in these calculus cases, especially if associated with a lowered phthalein and not tolerating a retained catheter, while requiring preparatory drainage. A study of my 1049 cases shows that a preliminary suprapubic drainage has been done in 11 cases—about 1 per cent—the usual cause being an irritable bladder or urethra which made catheter drainage intolerable. Not infrequently great care in adjusting the catheter and occasionally frequent changes had to be made during the catheter drainage. At times considerable urethritis would be engendered especially in prolonged cases. By resorting to intermittent catheterization, urethral injections of mild antiseptics and oils, almost all cases requiring drainage can be successfully handled by urethral catheter, as shown by the fact that I carried out suprapubic drainage in only 1 per cent of the 1049 cases. But why not do suprapubic cystostomy and insert a drain and be relieved of all the bother of a urethral catheter? Well one might reply:

1. Suprapubic drainage also requires considerable attention.

2. It is, I believe, contra-indicated in cases of large residuals and very low phthaleins where suppression is feared.

3. It is associated with a mortality of its own of at least 2 per cent. (Gardner says 3 per cent.)

4. As most cases require drainage 3 weeks or more, the suprapubic scar tissue is more of a hindrance to suprapubic prostatectomy than the fistula is a help.

5. Urethral catheter drainage is the safest and most satisfactory method. Unquestionably, however, some cases should be subjected to suprapubic cystostomy. What are these? In the last 3 years and 6 months the entire admissions for prostatic hypertrophy cases to the Johns Hopkins Hospital have been about 400, and among these there were 12 patients who died without undergoing prostatectomy. These cases presented many interesting problems, and I wish to discuss

TABLE III.—TWELVE CASES ENDING IN DEATH DURING PREPARATORY TREATMENT

Case No.	Hosp. No.	Symptoms	Condition	R. U.	Phthal. 2 hrs	Blood ur. gr. per L.	Urine inf.	Lived days	Cause of death. Autopsy
1	7682	Freq. urination, vomiting. Gen. debility	Bad. Uræmia	280	12	1.08	Bacil.	6	Uræmia, nephritis, diabetes
2	7793	Incontinence of urine	Fair. No uræmia	1240	17	0.48	Bacil.	28	No autopsy. Catheter not well borne. Fever. Infec.
3	8255	Freq. ur. Comatose	Bad. Uræmia	600	15	2.40	Bacil.	16	Uræmia. Autopsy: pyelonephritis
4	8348	Dysuria. False passage	Bad. Fever, uræmia	1200	0	0.88	Bacil.	10	Op. suprapubic drain. Autopsy: pyonephrosis
5	8481	Frequency great, pain, dysuria	Fair. No uræmia	800		2.36	Bacil. cocci	11	Autopsy. Abscess of prostate, sepsis
6	8585	Stupor, uræmia	Suprapubic drain, 2 mos.	S. Dr.	17	0.76	Bacil.	2	Uræmia, myocarditis, heart block
7	9035	Retention, stupor, fever	False passage, fever	500		0.60	Cocci bacil.	2	Sepsis, heart dis., uræmia. No autopsy
8	9275	Retention complete	Fair. No uræmia	1600	15	0.84	Cocci	5	Sudden death. Autopsy: pulmonary embolism
9	9311	Freq. urination. Œdema, feet	Weak. Short of breath	800			No	2	Autopsy: nephritis, myocarditis
10	10112	R. C. Drowsy	Bad. Mind clouded	900	32	0.50	Cocci bacil.	44	Autopsy: pyelonephritis
11	10173	Freq. urin. Weakness	Fair. Clear	1040	30	0.37	Cocci	12	Died of uræmia. No autopsy
12	10555	Freq. urin. Vomiting	Pale. Left kidney enlarged	850		2.16	Cocci bacil.	3	Died of uræmia. No autopsy

them in detail. As shown in Table III, in which these cases are given in abstract, five (Cases 1, 7, 8, 9, and 12) died within 6 days of entrance to the hospital, and three on the second day. Note the high blood urea, the low phthalein, the large residual, marked uræmia, and death from nephritis plus infection. In Case 8 the renal function was improving when sudden death from pulmonary embolism occurred. In other cases bladder drainage seemed to accelerate the onset of uræmia, in one case, regardless of the fact that realizing the danger of suppression as soon as I found 500 cubic centimeters residual urine present and no phthalein secreted, I began forcing water in every way. I did not, however, elevate the drainage tube so as to maintain bladder pressure, and this procedure might have saved some of them—as I have had many more desperate cases survive and later go through prostatectomy.

Several cases did not tolerate a catheter well, began to have fever and other signs of infection, and at death showed prostatic abscess or pyonephrosis. Cases 2, 5, and 10 belong to this group and might have been saved by a suprapubic operation under local anæsthesia. Two patients whose urethræ were badly traumatized by previous attempts at catheterization (Cases 4 and 7), should have had prompt suprapubic drainage and perhaps Case 4 might have been saved, for a suprapubic done 5 days after entrance did not save him—autopsy showed abscess of the prostate and of both kidneys.

Many of these cases were almost moribund, with kidneys practically destroyed by back pressure and infection when admitted. During this period I had in my own service two of these patients (Cases 4 and 12 above), the former of whom might possibly have been saved by more prompt measures.

Infections about the perineal urethra, the prostate and seminal vesicles are most important as portals of entry for an ascending or general sepsis, and house officers are instructed to be on the lookout and to make rectal examinations in the event of unexplained fever during the period of catheter drainage. Epididymitis usually subsides without operation, but may require drainage, and rarely may necessitate suprapubic cystostomy to do away with the inlying urethral catheter.

If prostatovesicular or retrovesical abscess occurs it should be drained perineally and the bladder opened suprapubically if the case is serious. Prostatectomy should not be carried out in the presence of prostatic abscess,—I lost one such case from a generalization of the infection.

RÉSUMÉ AS TO DRAINAGE

Cases in good condition, with good phthalein and small residual (200 cubic centimeters or under) may be operated upon without preliminary drainage or more than ordinary surgical preparatory treatment. Of my 1049 cases 462 were operated upon within 4 days of admission.

Cases with moderate or high residual, even if phthalein is good, should have preparatory drainage, and forced water treatment, but may often be operated upon in a week, if clinical and laboratory studies are propitious.

Cases with marked impairment of renal function, 30 per cent or less, should not be operated upon until phthalein has risen over 40 per cent or a prolonged treatment (3 weeks or more) has shown that the optimum has been reached, the condition of kidneys stable, the blood urea not over 0.5 gram per litre, and general condition fair. Six of my cases were under 20 per cent with only one death—but all but this one had proper preparatory treatment.

Cases with high blood urea (over 0.75) should receive most energetic treatment—(7000 to 10,000 cubic centimeters of water, by all avenues, daily) and the same applies to cases with renal infections, especially acute pyelitis which we have frequently washed away by forced internal hydrotherapy.

Cases with spasmodic, painful, or contracted bladder or urethra, some cases with calculi and occasionally with diverticula, tumor, ulcer, or severe cystitis, and also cases very difficult or painful to catheterize or tolerating an inlying catheter badly, with pronounced suppuration and epididymitis, often require suprapubic drainage.

In the two-stage suprapubic operation, the first stage is often the most dangerous, and in my opinion it is not justified as a routine procedure.

Almost every case can be brought into condition for perineal prostatectomy without a first stage suprapubic drainage. (In my 1049 cases only 11 had suprapubic drainage—1 per cent. In my last 200 cases only 2 died before operation, Cases 4 and 12 above, and none after prostatectomy.)

Occasionally one sees a very old or feeble man who is doing very well with a catheter life, to which he is well accustomed, and it seems safer to leave him alone. About 1 per cent of the cases are sent home thus without prostatectomy, which as a whole has now a much lower mortality than the catheter life.

Diabetes, acidosis, etc. Occasionally the diabetic has an obstructing prostate and the question of operative safety must be considered. I have had 12 cases in my series of 1049, and all have gone through operation and convalescence successfully. Most of the cases have been mild, but others have presented from 2 to 4 per cent sugar, and have required fairly energetic, prolonged antidiabetic treatment before operation could be undertaken safely. This treatment in addition to water in large amounts and soda has been entirely satisfactory, and from our experience we feel that practically all cases can eventually undergo perineal prostatectomy safely. The things to be avoided are ether anæsthesia, prolonged operation, hæmorrhage, and infection. I use gas and oxygen, and believe the perineal operation much safer because of the ability to stop hæmorrhage, secure dependent drainage, combat infection and prevent sloughing. The postoperative handling must be very alert and vigorous, especially if symptoms of coma appear.

Cardiovascular disease is very common in cases of prostatic hypertrophy. The well recognized cardiorenal relationship would lead us to expect it when 43 per cent of the cases have renal impairment below 50 per cent phthalein. Arteriosclerosis is so very common as to be negligible except in the very severe grades. Even with a history of previous cerebral attacks, or "apoplectic strokes," it is possible to carry out perineal prostatectomy successfully. In my histories there were more than ten cases in which one or more "strokes" with "paralysis" had occurred

before admission, and among these there were no deaths.

The blood pressure encountered is shown in the following table of my 198 consecutive cases without fatality.

TABLE IV.—SHOWING SYSTOLIC BLOOD PRESSURE IN LAST SERIES OF 198 CASES OF PROSTATIC HYPERTROPHY

	Cases		Cases
100–109	5	160–169	19
110–119	12	170–179	15
120–129	24	180–189	10
130–139	29	190–199	6
140–149	41	200–209	2
150–159	24	210–219	3

As seen here there are 55 cases in which the blood pressure was over 160 (27 per cent) and 5 over 200. That high blood pressure is not without danger, I know from two hemiplegic deaths in my longer series, immediately after operation (one a blood pressure of 220). Rest in bed, reduced diet, and, to a slight extent, drugs often reduce blood pressure considerably. Excitation before operation should be avoided, and morphia, given in the ward, is very valuable for this purpose. In these cases I always use "straight ether anæsthesia." Ether is a good cardiac stimulant and increases the blood pressure less than nitrous oxide. Spinal anæsthesia depresses it and some have advised its use in these cases, but I have no experience to offer.

Although high blood pressure is recognized as a signal for thorough study and great care at operation, I have found it possible to operate on practically all of these cases, even with a history of previous "paralytic stroke."

Heart disease was present in 48 per cent of my 198 cases (heart enlargement 17 per cent, murmurs 15 per cent, enlargement and murmurs 8 per cent, myocarditis 8 per cent). In most of the cases the lesion was not grave, no special treatment was given and nitrous oxide anæsthesia was employed. In other cases the condition was very serious, and great care was taken to get the patient in best possible trim under the direction of a competent internist, who usually administered to the patient before and during anæsthesia and after return to the ward. I will not attempt to describe the special therapeutics employed. From the urologist's standpoint it is interesting to know that almost all of these cases stand operation well and in 1049 cases there was only one operative cardiac death (patient died suddenly a few hours after operation).

But whereas patients with severe valvular lesion, dilatation, broken compensation and auricular fibrillation have been carried through perineal prostatectomy successfully, I will admit that an occasional patient, in very bad condition, who had learned to use a catheter successfully, was sent home without operation—but the sum total of these is very small.

Respiratory infections are extremely important to the surgeon, and in the face of an acute inflammation of the nose, throat, trachea, bronchi or lungs, we always delay operation to give the infection a chance to clear up. If fever is present, even 99.5° F., and the respiratory tract is suspected, operation is postponed. Where the infection is chronic, after appropriate treatment, the operation is done under gas and oxygen. Ether is certainly far more dangerous in these cases, and the use of gas-oxygen for 7 years has certainly cut down the number of pneumonias. Perhaps spinal or local anæsthesia may sometimes be indicated—certainly it is in tuberculosis of the lungs (I had one such death after ether) and pleurisy. The use of an antiseptic mouth wash and gargle (e.g., meroxyl 1:500) and medicated vaseline for the nose before anæsthesia deserves serious consideration as a preventive procedure.

Pulmonary embolism was responsible for one death during preparatory treatment and six after operation. It is a frequent cause of death in all operations below the umbilicus (I have seen it follow a simple varicocele and a suprapubic cystotomy). One patient died 3 weeks after perineal prostatectomy of pulmonary embolism immediately after taking an enema (and I know of other such occurrences). This has caused me to forbid enemata after all operations below the umbilicus. It is not clear how these accidents are to be always prevented, but straining in micturition, as well as at stool, is to be avoided, as well as infection and secondary hæmorrhage.

Technique

In a recent paper[1] I have discussed at length the various modifications in technique which I have made since its inception, and the reader is referred for details to that paper from which some illustrations have been taken. Suffice it to say here that only minor changes have been made in the technique. As now carried out the exposure is still through an inverted U perineal incision and reaches the prostate by blunt dissection on each side of the central tendon, opening up the space behind the transversus perinei muscles and triangular ligament, and after division of the median line structures (central tendon and recto-urethralis muscle,) the posterior surface of the fascia of Denonvilliers is exposed. Division of the posterior layer of this fascia gives the entrance into the space between the two which, in fœtal life, were peritoneum, and opens up a ready access to the prostate, seminal vesicles, and vasa deferentia. The advantage of this exposure over the old median line perineal incision is that the hæmorrhagic bulb is avoided, the external sphincter and triangular ligament are spared, the anterior surface of the rectum is visible and can be readily avoided, and the prostate is exposed to the light of day so that accurate operative procedures can be carried out. By means of the prostatic tractor introduced through the posterior part of the membranous urethra or the apex of the prostate, the hypertrophied mass can be drawn down into the field, and any technique which pleases the operator carried out in their enucleation. The original bilateral capsular incisions, which were used for many years, are splendid in preserving intact the verumontanum, ejaculatory ducts, and urethra, but have the drawback of requiring that the prostatic lobes be removed separately. In so doing it is more difficult to carry out a radical procedure upon all the hypertrophied masses present. Therefore we now open the urethra boldly by means of an oblique lateral or an inverted V incision (Fig. 3), and thus make it possible to enucleate in one piece the entire adenomatous hypertrophy including also the anterior commissure if this is involved. A little more mucous membrane is injured, but the ejaculatory ducts are preserved with equal certainty, and a far better chance is given to remove every vestige of the hypertrophied tissue and without injury to the neck of the bladder and internal sphincter (Figs. 4 to 13). By this technique it is possible to follow the hypertrophied tissue beneath the trigone and to remove a group of glands which, when hypertrophied, are usually not removed (Fig. 8) by the suprapubic operation and remain to give trouble with future obstruction. In some of our perineal operations, by the previous bicapsular technique, hypertrophied tissue was left in this region so that the method which we are now pursuing should give a definitely more perfect series of results and without necessitating the deep division or excision of tissues at the floor of the vesical neck, the sphincter and apex of the trigone as advised by Thompson-Walker and by some surgeons in America who follow the suprapubic route. (Figs. 5, 6, 7, and 8, frontispiece.)

The technique here referred to is graphically shown in the accompanying illustrations so that an extensive comment is unnecessary. The 1049 cases which we wish to analyze here have been done by the same technical method with the exception of the incisions in the prostate itself and in the urethra as above described. The results, therefore, will not be absolutely uniform in so far as the latter technique is more radical and it gives the

TABLE V.—SHOWING RELATION BETWEEN AGE AND MORTALITY AFTER PROSTATECTOMY

Age years	Cases	Deaths	Percentage
30 to 34	1		
35 to 39	3		
40 to 44	2		
45 to 49	15		
50 to 54	52	2	3.8
55 to 59	149	1	.7
60 to 64	247	6	2.7
65 to 69	204	11	5.7
70 to 74	215	5	2.8
75 to 79	113	6	5.3
80 to 84	28	2	7.1
85 to 89	2		
90 to 94	1	1	
Not given	3		
Total	1049	36	3.4

[1] Technique of prostatectomy in its relation to mortality. J. Am. M.

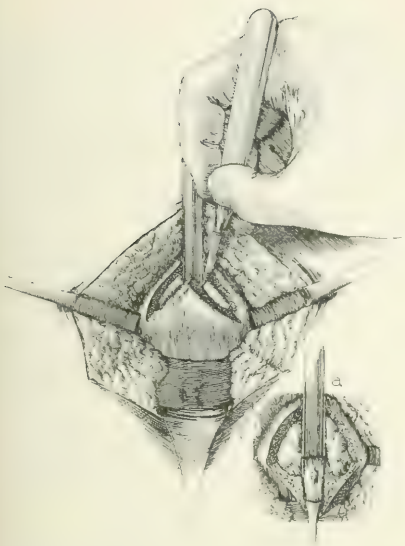

Fig. 3. Division of the left lateral wall of the urethra with scalpel. This is carried out also on the right side, thus making it possible to draw down the triangular flap with forceps and expose the floor of the urethra and ejaculatory ducts, as shown in inset, *a*, in which the urethra is divided on each side, the fold carried downward, and the lateral adenomata exposed.

operator a better opportunity to see points of bleeding, to arrest hæmorrhage, to place packing, etc.

Age as a causative factor of mortality is graphically shown in Table V. A glance at this table shows us that, with negligible variations, the mortality rate per cent increases gradually in each decade of life, but up to 75 years of age it remains very low, 2.8 per cent. After 75 years the operation is definitely more dangerous, but it is interesting to note that, during the last series of 198 cases without a death, there were 18 patients over 75 years of age (6 over 80)—all of whom went home well. Several successful prostatectomies in men over 90 years of age are recorded. One of my patients who had reached the age of 93 died, 2 weeks after operation, of cerebral thrombosis—apparently not associated with the operation.

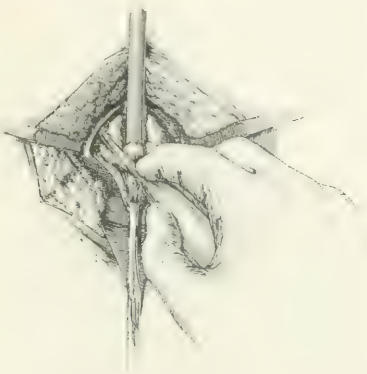

Fig. 4. Enucleation of lateral lobes begun with blunt dissector.

Postoperative Treatment

The results of this can best be portrayed by a mortality chart (Fig. 14). In 1049 consecutive cases there were 36 deaths in the hospital, a mortality of 3.4 per cent. In the accompanying chart the death rate has been charted by the succeeding years, the number of cases, and the deaths for each year being given, and from these the death rate, per cent, has been calculated and charted. This chart is interesting as showing a gradual decline in the mortality among my perineal prostatectomy cases from 8.4 per cent in 1903 to 2.4 per cent in 1919, and to none since then. During the 20 years included in the chart there have been two long periods in which there were no fatalities, first in the year 1906–1907 and part of 1908 in which there were 128 consecutive cases without a death (4 patients being over 80 and 43 over 70 years of age), and the second from February 8, 1919, to October 15, 1922 (when this paper was prepared), during which there were 198 consecutive cases without a death. During this last period there were only four patients in which operation was not carried out, and two of these died in the hospital (*vide supra*).

The pre-operative treatment by which these cases were prepared for a successful operation has been outlined. The post-operative complications may be grouped under

TABLE VI.—CAUSE OF DEATH AFTER PERINEAL PROSTATECTOMY IN 1049 CASES

Principal cause	Cases	Per-centage	Complications
Pneumonia	[illegible]	[illegible]	Old tuberculous lung, 1; myocarditis, [illegible]
Acute pulmonary œdema	1		Patient has recently recovered from pneumonia.
[illegible]	[illegible]	[illegible]	Hydronephrosis [illegible] from nose, 1; pneumonia, 1; hydronephrosis, double, 1.
Pulmonary embolism	4	1	[illegible] tis, dilatation heart, mural thrombus, 1; coronary thrombosis, 1; thrombosis femoral vein, 1.
Cerebral hæmorrhage	3	[illegible]	Marked arteriosclerosis general, 1; grave fear of operation, great mental [illegible]
Cerebral thrombosis	[illegible]	6	In one case, man, age 92, thrombosis [illegible] after operation.
Heart disease	1		Myocarditis, dilatation of heart, pyelonephritis.
Endocarditis	1		Bronchopneumonia.
[illegible] of wound	[illegible]	6	One case immediately after operation, due to insufficient packing; other case, secondary hæmorrhage at end of week.
Hæmorrhage from nose	1		Hæmorrhage from nose came on suddenly 3 weeks after operation when wound was healed.
Sepsis	[illegible]	[illegible]	
Abscess of spleen	1		Bronchitis.
Tuberculosis of lungs	1		Arrested case of pulmonary tuberculosis, ether anæsthesia, should have been operated upon under spinal.
Extravasated [illegible]	1		I made mistake of incising orifice of the diverticulum and as a result perivesical extravasation occurred.
Cancer of intestine	1		Patient died of intestinal complications; necropsy showed large unrecognized cancer of sigmoid.

various heads which may be discussed after giving a classification showing the cause of death in the 1049 cases charted in Table VI.

Our hindsight is better than our foresight. It is easy now to look over the above list of fatal endings and see how many of them should not have happened: for example, in the last mentioned, the carcinoma of the sigmoid should have been discovered and no operation performed. In the case above it, the extravasation came from an incision made in the neck of a diverticulum—a great mistake! The next with tuberculosis of the lungs should not have been given a general anæsthetic, etc., etc.

And it is a fact, as shown by the two long periods which were without a fatality, that by exercising the greatest care almost every patient can be prepared to go safely through perineal prostatectomy.

SHOCK

The prevention of operative shock is of great importance, and when we consider that about 40 per cent of the patients are over 70 years of age and many of them very feeble, we realize that great care must be taken. Our patients receive water in abundance up to the time of going to the operating room. This does not seem to lead to nausea or vomiting and prepares against the loss of blood. By quick operation, careful hæmostasis, ligation of bleeding arteries in the capsule of the prostate if possible, and thorough control of the bleeding after the drainage tube has been introduced, either by packing within the capsule and vesical sphincter or by pressure against the capsule posteriorly, the patient should leave the table in good condition with the hæmorrhage stopped. The operator should see to it that the hæmorrhage is controlled, and in some cases we put as many as 12 strips of gauze packing in order to secure this, but it is important that it should be persisted in until the hæmorrhage is controlled. One of the great advantages of the perineal route is that this is possible. Should the patient's pulse be very weak, an infusion or intravenous transfusion should be started before he leaves the operating room, and it is our invariable rule to give submammary infusions to every case on return to the ward. Should subsequent development show that the packing has not been sufficient to stop hæmorrhage, additional gauze should be introduced, preferably with a tubular packer which, when introduced deep into the cavity of the prostate, makes it possible to insert a large amount of gauze in the proper place without danger of injury to the rectum. In very feeble patients it is our rule to have blood matching done before operation, and if possible have a member of the family ready to give blood. Occasionally transfusion is resorted to with amazing results. Secondary hæmorrhage, following removal of gauze on the first or second day after the operation or sometimes later, may lead to considerable shock, which should be handled by repacking, infusion, or blood transfusion as necessary. In one of our cases hæmophilia gave us a great deal of trouble.

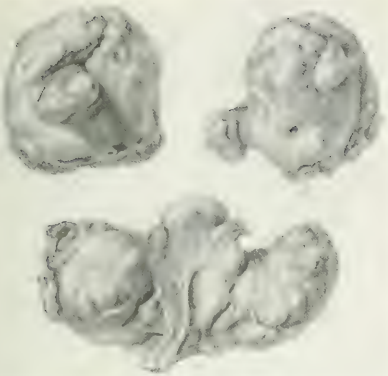

Fig. 9. *A*, Anterior view of lateral and median lobes removed in one piece; *B*, side view of right and median lobes of specimen; note the constriction of median lobe by sphincter and small subtrigonal posteriorly projecting lobule; *C*, vesical aspect of prostate, showing the small intravesical median and very large extravesical lateral lobes; if this had been removed suprapubically, the sphincter would have surely been destroyed.

Fig. 10. Specimen removed by foregoing technique, consisting of very large left lateral (*L. L.*), moderated right lateral (*R. L.*), and very long median lobe (*M. L.*), which projects far into the bladder. No mucous membrane removed.

As seen in the above chart there were two deaths from hæmorrhage: one on the day after operation and another 6 days later. The first could have been prevented by more packing which was very inadequately done in this case. The latter case was a secondary hæmorrhage which could not be controlled even by suprapubic cystostomy and packing.

PULMONARY COMPLICATIONS

As seen in Table VI pneumonia has been the most frequent cause of death, 22 per cent. A few of these were ether pneumonias, but, since the introduction of nitrous oxide-oxygen anæsthesia, operation-pneumonias have not occurred, but several cases have developed pneumonia in 2 or 3 weeks after the operation. The prevention of these complications is difficult. It is important that the patient should be up and about, as it is dangerous for old men to be in bed, and on this account it is our rule to get them out of bed in a few days, and have the patient walking within a week or 10 days. Great care should be taken to avoid chilling, exposure to cold, and association with others who have acute respiratory infections. The use of gargles and mouth washes and oil in the nose is also of much help.

Uræmia, which has been the cause of death in 20 per cent of the cases, is a direct result of the serious impairment of the kidneys from back pressure or infection which is generally present before operation, but may result from ascending infection after operation. One must take grave risks of uræmia occurring, but by prolonged catheter drainage, and the use of water in large amounts, the patient can usually be brought into a safe condition for operation. It is absolutely essential, however, that the imbibition of water should continue after operation, and if nausea or refusal of the patient to drink should interfere, salt solution should be given by infusion or by rectum or by transfusion, and, if the onset of fever and localizing symptoms indicate that a pyelitis has supervened, the water cure should be forced with redoubled activity by every possible means. I have seen numerous cases in which this has occurred, and it is most extraordinary how it is possible to wash away acute renal infections and severe uræmias.

Nausea and hiccough, on account of their interference with the "water cure" are of

Fig. 11. Enucleation of prostate *en bloc*, with anterior commissure intact. *A. C.*, Anterior commissure.

Fig. 12. Anterior view of hypertrophied prostatic lobes removed *en bloc* with anterior commissure and a portion of the prostatic capsule; glass tube shows site of urethra.

very great importance, and should be combated most vigorously. The use of a stomach tube is often of great help, and when one drug will not work another should be tried, especially in cases of hiccough. In my opinion there is no one specific.

CIRCULATORY COMPLICATIONS

Cardiovascular complications are of the next importance. Pulmonary embolism was the cause of death in 12 per cent of the cases. It sometimes occurs as a result of endocarditis or other cardiac diseases, but as a rule the clot comes from the region of the wound. Two such cases followed the taking of enemata and one case followed a femoral thrombophlebitis. Phlebitis of the veins of the leg occurs occasionally and should always receive the greatest care; the patient should be kept absolutely quiet until the danger of embolism has passed.

Cerebral hæmorrhage occurred in three cases. When we realize that fully 50 per cent of the patients have arteriosclerosis and abnormally high blood pressure, it is remarkable that it does not occur more often. Two of these patients were found to be hemiphlegic immediately after the operation; one had a very high blood pressure—over 220, and the other was a man who was extremely nervous and fearful of death. *Cerebral thrombosis* occurred in two cases. One, a man aged 92, was up and about and almost ready to go home 3 weeks after operation. He complained of some pain in his wound, and was given aspirin. He died very soon, and autopsy showed cerebral thrombosis. An explanation of death in this case was that the aspirin had lowered the blood pressure and slowed up the pulse, so that thrombosis in the sclerotic cerebral vessels occurred.

Heart disease was immediately responsible for only two deaths, and when we consider that fully 50 per cent of the patients were suffering from cardiovascular disease, and many of them with grave cardiac lesions, as stated previously, it is remarkable that there were not more. Surgeons have long been aware that cases with heart disease go through operation under ether anæsthesia with remarkable facility, and on this account we have operated on many a patient in which a cautious clinician has advised against operation. It is extremely important, however, to take every care, and to have the assistance of the best internist, because much can be done with digitalis, quinidine, and other drugs to get the patient in trim for operation and to carry him safely through the convalescence.

INFECTION

There is no more important feature of the treatment than the prevention or combating of sepsis. As stated before it is almost impossible to carry out frequent or long-continued urethral or suprapubic drainage without infection. The colon bacillus is the most common organism and is usually not very virulent. Efforts should be made to prevent cocci from being added to the infection, and this can usually be done. The colon bacillus may, however, produce very severe cystitis, prostatitis, epididymitis, and ascending renal infections. Of these, epididymitis is the most frequent and may be sufficiently severe to require incision and drainage, especially if the patient is feeble or if he continues to run fever or show evidences of considerable toxæmia. The great majority of the cases, however, can be controlled by ice packs and resolve without operation. Infection of the wound and bladder should be treated by mild irrigations, preferably of some of the newer antiseptics, meroxyl 1:2000, acriflavine 1:8000, mercurochrome 1 per cent or Dakin solution (if accompanied by breaking down or sloughing of the wound). It is rare now to see the nasty perineal and suprapubic wounds, encrusted with urinary salts and accompanied by necrotic tissue, such as we used to see so frequently. Ammoniacal cystitis, with its rapid deposit of phosphatic calculi, is practically a thing of the past as a result of modern antiseptics. Hexamethylenamin is of slight value, unless given in large doses and in conjunction with sodium benzoate.

Ascending infections of the kidney pelvis and cortex can usually be dealt with by internal hydrotherapy, submammary and intravenous infusions often being necessary. Occasionally a definite abscess forms or the condition becomes so serious that a hasty drainage operation is necessary.

The use of drugs intravenously to combat sepsis looms up as a method of the future. Piper has reported 4 cases of septicæmia, due to the streptococcus hæmolyticus and one to the staphylococcus aureus, which had been cured by the intravenous injections of mercurochrome 5 milligrams per kilogram of body weight, 1 per cent solution being employed. We have recently had one case of general colon bacillus septicæmia cured by 34 cubic centimeters of a 1 per cent solution of mercurochrome. These remarkable results should lead to the wide use of this drug to combat general infections. To accomplish results, however, full dosage, as employed by Piper, should be adopted. Other antiseptics, collargol, silver iodide, etc., have been employed for similar purposes.

Fig. 13. Moderate hypertrophy of the lateral lobes with long middle lobe removed with anterior commissure.

GASTRO-INTESTINAL COMPLICATIONS

Nausea, vomiting, distention due to obstruction, or severe obstipation present problems of the greatest importance and have required minute attention and vigorous treatment. The use of gas anæsthesia has done away with almost all of the postoperative nausea and vomiting, and it is possible to have the patient drink water in abundance early. In this way uræmic vomiting is prevented in most cases. Abdominal distention from obstipation or intestinal obstruction or undue gas formation, is nothing like so common from perineal as from suprapubic prostatectomies, but it

may be a most serious complication, and every effort should be made to prevent its occurrence A few doses of white oil before and immediately after operation, followed by a gentle purgative is generally sufficient, but if the bowels become greatly distended, the use of a urethral catheter inserted high into the rectum and pituitrin supplemented with hot stupes, and other appropriate measures has usually been effective in our cases. Enemata of course would be useful, but owing to two deaths from pulmonary embolism following enemata their use has been prohibited upon operations of the pelvic organs and genitalia at my clinic.

CARE OF WOUND

The care of the wound has been made extremely simple in cases upon whom perineal prostatectomy has been done. The drainage tubes and gauze are generally removed within 24 or 36 hours after operation and are not replaced, urine being allowed to escape through the lateral perineal wound, which is irrigated superficially with a mild antiseptic by the orderly at each change of the dressing and after bowel movements. Five or six days after operation fluid is forced through the penile urethra so as to open up the membranous urethra and prepare the way for the closure of the wound. Passage of sounds is not necessary and is only adopted when 2 weeks or more after the operation normal urination has not been established and it seems evident that the urethra has become coapted or contracted in the membranous region in front of the urethrotomy. But even then the instrument is only passed through the membranous urethra, and no attempt is made to enter the bladder, as it is advisable not to traumatize the verumontanum for fear of producing an epididymitis. In rare instances a blood clot or swelling of the internal sphincter may lead to obstruction and require the insertion of a catheter through the urethra or drainage tube through the perineal wound, and in some cases in order to hasten the closure of the fistula a retained urethral catheter may be employed. The patient is allowed to be up and about as drainage is best when in sitting or standing posture.

CLOSURE OF FISTULA

This is usually spontaneous and within the first 3 weeks after operation. In our experience 23 per cent closed within 14 days, and a persistent fistula is extremely rare and does not furnish the bugaboo which has been held against the perineal operation by certain writers. As a matter of fact it is not so common as a persistent suprapubic fistula in my experience, and is infinitely less disagreeable as there is no continuous leakage as in suprapubic cases, but only the escape of urine at urination, patient being dry the rest of the time. In a very exhaustive study of 450 cases I have found only 5 in which the fistula was present after prolonged period; three of these were paupers, and had not received proper treatment after leaving the hospital. The use of the curette is of assistance in hastening the closure of fistulæ and a sound should be passed so as to be sure that no stricture or valve formation is present in the urethra.

Although we are insistent that the patient remain in the hospital until the fistula has been closed 3 or 4 days, 64 per cent of the patients have left the hospital inside of 4 weeks and only 5 per cent have remained more than 8 weeks. When we consider the great age and serious condition of many of these patients, this shows that the convalescence from perineal prostatectomy is comparatively short and simple.

In some cases we have tried to render the bladder, which is practically always infected, sterile by treatment, and in a few instances have succeeded in killing off all bacteria in a few treatments. In most cases, however, this is impossible and as a rule we depend largely upon the abundant drinking of water and time to eradicate the bladder infection. It is remarkable how many return after a few months with sterile urine. If a severe cystitis is present and particularly if it is alkaline with a tendency to a deposit of lime salts, irrigations with or without a catheter may be advisable and here the newer antiseptics, above referred to, are of great value in conjunction with nitrate of silver and permanganate of potash.

The act of micturition, which is materially altered by the considerable impairment or

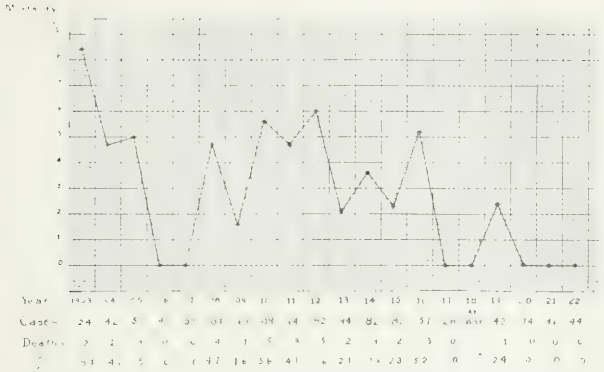

Fig. 14. Chart showing annual mortality rate for the past 20 years, the number of cases operated on each year and the number of deaths among these cases is recorded, and mortality percentage is given on the bottom line. Seven years in which there was no mortality are recorded.

derangement of musculature about the vesical neck or perineum after any form of prostatectomy, may not return to normal for several weeks or months. The bladder is usually contracted and urination on this account more frequent than normal. The weakness of the internal and sometimes of the external sphincter leads to a slight escape of urine on coughing, sneezing or sudden movements, in some cases for several weeks after the operation. By retaining the urine as long as possible in a sitting posture and exercising the sphincter muscles by attempting to cut off the outflow of urine several times during each urination, it is possible in most instances to restore normal urination very promptly; in some cases more prolonged exercise must be undertaken.

Incontinence of urine occurs very rarely. In my 450 cases presented before the International Medical Congress in 1911, there was not a single case of complete incontinence—dribbling night and day. There were three cases of incontinence when the patient was on his feet, and in one of these the operative notes show that the muscular structures in the region of the triangular ligament were injured at operation, and this probably occurred in the other two cases. There were 4 other cases of occasional slight leakage, and cystoscopic examination showed that the prostate had not been completely removed and that an irregularly dilated posterior urethra was present in which urine collected and from which it occasionally escaped.

There is no question but that the fear of incontinence of urine has been responsible for the unpopularity of the perineal route. But this came about as a result of the old-fashioned median perineal incision which passed through the external sphincter and triangular ligament and through which the prostatic lobes were removed piecemeal. It is remarkable that all of these cases were not incontinent, not only on account of the destructive injury of the external sphincter, but on account of the fact that not infrequently deep prostatic lobules were left behind. Ever since my early publications on this subject I have insisted on a careful open operation back of the bulb, transversus perinei muscles, triangular ligament and external sphincter, all of which structures should be seen and carefully avoided, and the urethra opened far back near the apex of the prostate well behind all sphincteric fibers. In an early paper I discussed the use of a long tractor through the urethra or the insertion of a tractor through the bulbous urethra in order to avoid an opening through

TABLE VII ANALYTICAL STUDY OF 1049 CONSECUTIVE CASES OF PROSTATECTOMY BY H. H. Y., UP TO OCTOBER 15, 1922

Ages	Cases	Residual urine	Preliminary treatment	Preliminary treatment: Duration of drainage	Cases	Closure of fistula in 158 cases: Weeks	Closure: Per cent	Operative results	
Under		Cc.m		Days					
[illegible]	16	Under	Cases	Continuous	85	1	[illegible]	Normal before operation	133
[illegible]	[illegible]	[illegible]	[illegible]	catheter	[illegible]	[illegible]	[illegible]	Erections normal	75 per cent
[illegible]	[illegible]	50–99	[illegible]	Intermittent	[illegible]	[illegible]	[illegible]	Coitus normal	50 per cent
[illegible]	[illegible]	100–199	[illegible]	catheter, 60	[illegible]	[illegible]	[illegible]	Patients under 70 years	per cent
[illegible]	[illegible]	200–299	[illegible]	Suprapubic	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	300–399	[illegible]	drain	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	400–499	[illegible]	Suprapubic	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	500–699	[illegible]	aspiration	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	700–899	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	900–1099	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	1000–1499	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	1500–1999	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
Total	[illegible]	2000–2499	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
Over 70 years	[illegible]	2500–2999	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
Over 80 years	[illegible]	No information	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

[illegible] Deaths: Among these 1049 consecutive cases by H.H.Y. there were 36 deaths, a mortality of 3.2 per cent. In this series over a period of 20 years there [illegible]

the membranous and prostatic urethra, but the cases in which I tried this showed that the traction obtained was less perfect and the operation lengthened. The use of the long tractor has been continued in operations upon the tuberculous prostate and seminal vesicles, and Dr. Geraghty has recently advised its use in cases of prostatic hypertrophy with the object of completely avoiding the membranous urethra. Time will show whether much is to be gained by this. Cecil has also tried the same scheme with the same object, but I personally believe that if one is careful to see the anatomical structures and particularly to avoid injury to the transversus perinei muscles and triangular ligament (which injury occasionally has happened in my hands from faulty exposure), no difficulty will be experienced in reaching the apex of the prostate and making the incision at a point where no possibility of injury to the external sphincter is present. With this precaution the act of micturition after perineal prostatectomy is distinctly more perfect than after suprapubic prostatectomy because the internal sphincter is usually restored to normal after perineal prostatectomy whereas, after suprapubic prostatectomy, it is usually widely dilated, and as shown by Hyman, Thompson-Walker and others, generally forms a dilated gourd-like neck to the bladder, the urine of which fills the posterior urethra down to the external sphincter. The same thing can be said in regard to rectal fistulæ they should never occur except in extremely rare instances as a result from suppuration. The rectum has been injured in something less than 1 per cent of the cases, but practically all of them have been cured by the operation published by Stone and myself, which is similar to a procedure of Wildbolz. The injury of the rectum is certainly less common and less dangerous than cutting or tearing into the peritoneum, as in the suprapubic operation, which has a definite mortality of its own.

The general statistics of my 1049 consecutive cases are shown in Table VII.

Summary Results Obtained in 198 Recent Cases

As an evidence of what might be accomplished by the methods which I have outlined above, I thought it well in closing to bring before you a brief analytical report of 198 consecutive cases in which I have personally operated since my return from France in February, 1919, a period of 3 years and 9 months. During this period there have been 198 cases, and we have had the good fortune to have no fatalities. The analysis of these cases is shown in Tables VIII and IX. These tables need very little explanation. It may be noted that 58 patients 21 per cent. were over 70 years of age, that the blood pressure was 100 or more in 55 cases, 28 per cent. that the phthalein was below 50 per cent in 93 cases, 45 per cent, the blood urea over

TABLE VIII.—ANALYSIS OF 198 CONSECUTIVE CASES OF PERINEAL PROSTATECTOMY WITHOUT A DEATH—FEBRUARY 8, 1919, TO OCTOBER 15, 1922

Ages		Residual		Blood pressure		Phthalein		Blood urea	
Years	No.	C.cm.	No.	B. P.	No.	Per cent	No.	Grms.	No.
50–54	13	0–40	40	100–109	5	0–9	11	0.40	109
55–59	26	40–99	31	110–119	12	10–19	21	0.50	39
60–64	48	100–199	57	120–129	24	20–29	10	0.60	19
65–69	50	200–299	21	130–139	20	30–39	17	0.70	10
70–74	40	300–399	11	140–149	11	40–49	36	0.80	09
75–79	12	500	4	150–159	21	50–59	8	0.90	09
80–84	6	600	6	160–169	19	60–69	46	0.95	1
No information	1	900	1	170–179	15	70–79	14	0.70	5
		1000	1	180–189	13	80–89	2	0.60	2
		1200	2	190–199	6	90–99	1	0.50–0.59	3
		1800	1	200–209	2	No information	4	0.40–0.49	16
		Compl. R. U.	218	210–219	3			0.30–0.39	16
			12	No information	6			0.20–0.29	20
		No information	20					0.10–0.19	4
								0.01–0.09	1

TABLE IX.—ANALYSIS OF 198 CONSECUTIVE CASES OF PERINEAL PROSTATECTOMY WITHOUT A DEATH—FEBRUARY 8, 1919, TO OCTOBER 15, 1922

Heart		Discharge		Fistula closure		Result on discharge	
No.		Days	No.	Days	No.		
Enlarged	21	10–14	5	5–9	2	Well	165
Murmur	30	10–19	1	10–14	19	Improved	25
Enl. and Mur.	16	20–24	40	15–19	88	No information	6
Myocarditis	16	25–29	22	20–29	51		
		30–39	86	30–39	19	Ultimate results	
Preliminary treatment	No.	40–49	9	40–49	6	Cured	129
		50–59	9	50–59	8	Improved	10
None	52	60–69	8	60–69	1	Not improved	1
Catheter continuous	130	70–79	1	100–104	1	No information	56
Intermittent	6	Over 90	6	Average 24 days		Deaths after 6 mos.	5
Suprapubic	4	No information	1			Deaths before 6 mos.	2
No information	34						

0.50 grams per litre in 15 cases, 8 per cent, and some form of heart disease in 96 cases, 49 per cent. Preparatory treatment with a catheter was carried out in over 60 per cent of the cases, but suprapubic drainage was employed in only 4, or 2 per cent, of the patients. The average length of stay in the hospital was 32 days, and the average duration of the fistula 24 days, 14 per cent being open on discharge. As the cases are recent the ultimate result is incomplete, and the 56 cases on which no information is cited are mostly recent cases. The fact that 198 consecutive cases, many of which were very old, feeble patients with markedly impaired kidneys and heart, can be carried through perineal prostatectomy without a death shows very effectively the benignity of this operation.

Discussion

By ALEXANDER RANDALL, M.D., Philadelphia

It is extremely difficult for me to discuss in any critical way the work of Dr. Young, recognizing in him the pioneer in investigating and solving so many of the problems of modern urologic surgery. Certain it is that a long day will pass before the remarkable recovery record which he has reported to you tonight will be equalled.

It is always pleasant to talk of the success of prostatic surgery, returning benefits of a most gratifying nature, in patients least likely to endure an operative procedure. The percentage of successes today is fortunately high, and we have lived to see a mortality rate that was shocking reduced to a nation-wide average of about 10 per cent: ninety successes and ten failures. From this point on I believe a further reduction will be gained more readily by a close analysis of the failures, than by a greater perseverance in the methods that have been productive of this success. Moreover, we *must* add to the 10 per cent of failures (actual mortality) another equal percentage where recovery took place perhaps, but only a partial return of normal function followed. To be fair we must all recognize that such are also surgical failures, and are apt to be errors of an operative technical character that have left us a living patient, to be sure, but one with a urinary frequency, or a persistent residual urine, a persistent fistula, or even a return to catheter life.

It is this group presenting a morbidity, to which I wish to draw your attention this evening, feeling that with the splendid progress made in the past two decades in the reduction of actual mortality, we should now bend our efforts toward the complete eradication of those disagreeable sequelæ which cause prostatectomy to have this postoperative morbidity.

First of all, let me consider from a different angle than the usual, the long mooted question of the choice between suprapubic and perineal prostatectomy.

My studies have convinced me that the prostate, in hypertrophying, shows a predilection for one of two fixed ways of enlarging, and in this difference the internal sphincter plays a very

important rôle. Hedged about by fixed anatomical structures, an enlarging gland must ultimately grow upward. In doing so, the most frequent path of growth is by a gradual dilatation of the internal sphincter and a gradual herniation of the hypertrophying prostate through it into the bladder cavity. The second mode of enlarging is likewise upward, but in this type of case, the internal sphincter remains tonically closed and the prostate, in hypertrophying, raises it and the entire bladder mass without dilating the sphincter at all, it never becoming anything more than a hypertrophied gland remaining within its anatomical limits.

It can be quickly seen that this difference as to whether or not the internal sphincter is dilated, creates a preference as to whether the prostate be removed by the suprapubic or the perineal operation. I consider the careful preservation of the internal sphincter, with its return to normal function postoperatively an essential to a perfect operative result.

Following these two types to their proper surgical handling, it is easily seen that in the first the whole growth has *gradually* dilated the internal sphincter. The surgical indication here is to remove that growth by suprapubic prostatectomy, and in doing so, the dilated sphincter will neither be in the way, nor will it be injured by such enucleation. Following such an operation, it may be expected that the internal sphincter would regain its tonicity and return to function.

In the second type, however, it would be impossible to enucleate such a prostate without first dilating the internal sphincter. It is very dubious whether such could be done satisfactorily at the moment of operating, and in doing the enucleation the result must be that such a sphincter is inevitably lacerated. Again it is very questionable whether such a lacerated muscle would ever regain its functional capacity, and this is the type of hypertrophy which should be removed by the perineal operation, in which the sphincter would neither be dilated nor injured and its functioning ability in nowise hampered. Likewise, this is the type where, following perineal prostatectomy, one can feel, after the enucleation of the prostate, a tight ring about one's finger in the vesical orifice; it is also the type occasionally seen where one enjoys the delightful experience of having a perfectly continent patient immediately following removal of perineal drainage tube.

Close cystoscopic study is necessary for a preoperative decision as regards this point of the dilatation of the internal sphincter, and on it should be based the choice of operative approach.

The second point I wish to make relative to the technical performance of prostatectomy concerns the presence or absence of median lobe enlargement. It has been sufficiently proven, by various investigators in the past, that there is no longer any question as regards the pathological development of a middle lobe of the prostate. When such is present, dilatation of the sphincter is always the case, and suprapubic prostatectomy is the operation of choice. The one particular point that I wish to make is the possibility, and it is a frequent one, of the middle lobe being the sole obstructing feature, and in the total absence of lateral lobe enlargement. In such a case, the usual stigmata of prostatic hypertrophy obtained by rectal examination are absent and cystoscopy alone will render an accurate diagnosis.

One must constantly keep in mind the possibility of such solitary median lobes, wherein the clinical history and the catheter examination suggests prostatic obstruction, but where rectal examination reveals a prostate in nowise above normal in size.

The third technical error that I wish to discuss with you is the proper handling of that condition spoken of as "contracture of the vesical neck," "sclerosis of the internal sphincter," or as "median bar formation." Parenthetically, let it be said that this pathological condition gives a clinical picture identical with that of hypertrophy. Examination likewise reveals a varying amount of residual urine, while generally a small, even atrophic, prostate is felt on rectal examination.

We have all heard the surgeon remark at operation that he unfortunately was dealing with a small sclerotic prostate. Today I would deem such a gross error of surgical diagnosis, and an even worse error of surgical operative technique. Such prostates cannot be enucleated; the process is one due to inflammation and not hypertrophy. Its proper surgical handling requires the removal of the obstruction due to the sclerosed posterior vesical lip. The choice of method by which such should be done varies with the judgment of the surgeon. Such tissue may be destroyed by fulguration; by urethroscopic punch operation (aided or not with the cautery); or by suprapubic cystotomy and excision of a wedge of tissue from posterior lip of vesical orifice.

These are, therefore, three salient points of an operative technical character that I feel are frequent errors of judgment, and are no doubt likewise frequent reasons for an incomplete recovery following prostatectomy, and the cause of a postoperative morbidity that should not exist.

By JOHN H. CUNNINGHAM, M.D., Boston

Dr. Young's brilliant results as regards mortality in connection with prostatectomy in his series of cases, is evidence of what may be accomplished in this malady, which is all the more gratifying when one realizes that the majority of these patients upon whom he has operated are in the period of physical decline.

It is due to Dr. Young, perhaps more than to any other individual in the history of genito-urinary surgery, that prostatectomy may be ranked among the operative procedures carrying a relatively low mortality.

Some 20 years ago when I first became interested in prostatic surgery, the mortality was in the vicinity of 20 or 30 per cent, the patients dying rarely of hæmorrhage, occasionally from sepsis, and most frequently from uræmia. About that time Dr. Young began to show a far better mortality record than was being attained by other noted operators, and I became interested to learn, if possible, what Dr. Young had as a protective measure that the other operators did not possess.

Associating myself with him for a brief time, I discovered his secret. Dr. Young had appreciated that associated with prostatic obstruction was a resulting residual urine, that there was impairment of renal activity and efficiency, and he was correct in his interpretation that improvement in this kidney condition took place by constant drainage of the bladder to relieve kidney back pressure and infection, and forcing of fluids to dilute and produce a greater elimination of the toxines resulting from renal impairment and sepsis.

It was the appreciation of these features, then as now, which are the important features upon which the success of prostatic surgery depends. As Dr. Young has stated, he prefers to secure this adjustment by bladder drainage with the catheter passed through the urethra rather than by suprapubic drainage. I am surprised, however, at the small number of patients in his series requiring suprapubic drainage. Personally I agree with Dr. Young that urethral drainage with the indwelling catheter is the method of choice, and that suprapubic drainage, as a preliminary step to prostatectomy, is the procedure of necessity only.

The essential feature, however, to make prostatectomy safe by either the suprapubic or perineal route, depends upon bladder drainage over a sufficient time to establish the maximum renal efficiency, and the saturation of the patient with fluids to diminish toxæmia to the minimum.

Today we can judge of the kidney value by renal function tests and blood chemistry. As Dr. Young has just shown, there has been an increase in the phenosulphophthalein output and a diminution of the nitrogen retention in the blood, dependent upon bladder drainage and forced fluids.

Experience has shown that there is a certain standardization in regard to kidney elimination and nitrogen retention in the blood which, being attained, gives assurance in regard to the safety of the operative procedure of prostatectomy. An attempt should be made to bring about such a standardization before prostatectomy is undertaken.

Dr. Young's series deals entirely with the perineal dissecting operation, an operation which can only be properly executed by one who has a special knowledge of the technique, and for that reason the operation, in the hands of good surgeons, but without the special knowledge required, has resulted in operative difficulties and unfortunate sequelæ, so that the operation has not been given the general recognition which it justly deserves.

It is natural that the surgeon accepts suprapubic prostatectomy in preference to the dissecting perineal operation because of its lesser technical requirements. It may not be realized, however, that suprapubic prostatectomy carries a mortality at least twice as high as that of the perineal route.

Personally I think the whole subject of perineal versus suprapubic prostatectomy may be summarized in a general way by the statement that suprapubic prostatectomy carries twice the mortality, but in the hands of most, there may be expected a better average functional result.

The best manner of dealing with malignant tumors of the bladder is one of the unsettled problems of genito-urinary surgery. The technique described by Dr. Squier[1] is, without question, the proper one to be employed in cases where eradication of the disease, by surgery, is to be undertaken.

The essential feature, as Dr. Squier emphasizes, is to free the bladder so completely from its bed that it can be drawn out of the suprapubic wound and the resection of the diseased area carried out, leaving a liberal margin of normal tissue about the growth, dividing the ureter when necessary

[1] J. Bentley Squier: Segmental resection of the bladder for neoplasm. In press.

to accomplish this, and implanting it into a healthy portion of the bladder.

Nothing short of the extensive operation as described by Dr. Squier should be attempted.

There is nothing I can say in connection with the particular type of bladder tumor which Mr. Kidd[1] has described, and which he considers to be the rarest of all tumors found in the urinary bladder, except to emphasize the importance of the careful pathological study of surgical specimens, without which we would not have been favored with this communication.

The study of bladder tumors, during the past twenty years, has been perhaps more clinical than histological, because of the perfection of the cystoscope and development of non-operative therapeutic measures.

As a result, certain visual characteristics determine bladder tumors to be benign or malignant by cystoscopic investigation, and since the introduction of fulguration by Beer in 1910, most benign tumors have been subjected to such treatment rather than operation, and particularly during the past few years the employment of radium further reduces the number of tumors removed surgically, and the opportunity for pathological study is therefore less frequent, especially in benign tumors, so that the rarer types may be even less frequently recognized.

I cannot refrain from adding, however, that I strongly feel that malignant or questionable malignant bladder tumors require extensive resection, and it will be this, quite largely, from which we may obtain further histological information.

Mr. Fullerton's admirable contribution[2] showing so conclusively that a kidney, affected by disease, may be expected to secrete a urine of relatively low specific gravity, is a very important fact. The realization that the specific gravity of a urine secreted from a diseased kidney will be lower than from a normal kidney, taken together with the other information obtained by simultaneous collection of the urine from each kidney, by ureter catheterization, gives us an additional diagnostic feature in determining the relative renal values. Like so many clinically established facts in medicine, the explanation may remain in debate, as Mr. Fullerton's remarks indicate in this instance. It is, however, the clinical facts which concern us primarily as clinicians and surgeons, and Mr. Fullerton's observation deserves most sincere appreciation.

[1] Management of the urinary bladder. Surg., Gynec. & Obst., 1923, xxxvi, 2.

[2] Unilateral diuresis. Surg., Gynec. & Obst., 1923, xxxvi, 16.

STOFFEL OPERATION FOR SPASTIC PARALYSIS

With Report of Twenty-four Cases

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THE object of this paper is to present a preliminary report on the results obtained in spastic paralysis by means of the Stoffel operation. Fifty-nine operations were done in 24 cases. Although a sufficient length of time has not elapsed for a final report, the results as a whole, particularly in certain types as compared to other commonly used methods, are so encouraging as to warrant the belief that they will be permanent, and even grow better as time passes.

The tendency is prevalent to consider treatment hopeless, or that the results obtained over an extended period of treatment do not show sufficient improvement to justify the effort, particularly since a large number of these patients are more or less mentally defective. This may vary from the completely normal mind to that of the hopeless idiot. Deficient mentality of whatever grade is no excuse for declining treatment, if there can be any expectation of making the child better able to care for itself and thus relieve the parents of a great load. However, a great proportion of these patients are not idiots, and, if we can enable them to walk, or relieve them of disabling and conspicuous contractures, they will become less a burden, and may become more useful members of society. Again, a decided improvement in the mentality is frequently noted in those mentally defective patients in whom contractures have been relieved, thus allowing better muscle co-ordination and balance. It is probable that education in co-ordination is a stimulant to the higher centers. Whatever the explanation, surprisingly rapid improvement often occurs.

There are four clinical types, and the degree of mental involvement, as a rule, is directly in proportion to the extent of the spasticity. In the order of their frequency they are—

1. Spastic diplegia, or involvement of both the upper and lower extremities. In this class the most marked mental impairment is usually seen;

2. Spastic paraplegia, or involvement of only the lower extremities. The average mentality is better than in Class 1;

3. Spastic hemiplegia. Here the central lesion is on one side only, and is usually of less extent than in bilateral involvement. The mentality is usually good;

4. Spastic monoplegia, or involvement of a single arm or leg. This is relatively rare, for signs of a slight spasticity in the corresponding other extremity may generally be found as evidenced by more active deep reflexes. The central lesion is small and mental impairment is rarely seen.

From an operative standpoint, we are not interested in the etiology as the damage has been done and is irreparable, except in those cases which are the result of increased intracranial pressure for which Sharp does his decompression operation. However, to understand fully the nature of the process with which we are concerned, a review of the various possible etiological factors may not be amiss. Tubby (1) classifies spastic paralysis as follows:

A. Intra-uterine origin—
1. Large cerebral defects, such as porencephaly, and absence of the gray matter;
2. Hæmorrhage and softening;
3. Microcephaly;
4. Syphilis;
5. Specific fevers;
6. Eclampsia and convulsions;
7. Injuries;
8. Repeated pregnancies.

B. Traumatism during labor.

C. Acquired after birth.
1. Meningeal hæmorrhage, embolism, thrombosis from syphilitic arteries and in association with marasmic conditions; as a result vascular lesions, cysts, softening, atrophy and sclerosis;

2. Chronic meningitis;
3. Hydrocephalus;
4. Primary encephalitis (Struempell).

The aim of treatment is to develop voluntary control and co-ordination of muscles. In the milder cases where no contractures are present and the patient possesses a good grade of intelligence, this can be accomplished by a system of muscle training and massage which can only be carried out by one who has been especially trained for such work, and who has unlimited patience over painstaking details. Contractures must be relieved before restoration of muscle balance can be accomplished. The procedures that have been employed are:

1. Tenotomies;
2. Tendon transplantations;
3. Resection of the posterior nerve roots of the spinal cord (Foerster's operation, 2);
4. Cranial decompression (Sharp and Farrell, 3);
5. Temporary paralysis by alcohol injection of nerves (Allison and Schwab, 4);
6. Intra-perineural neurotomy (Nutt, 5);
7. Partial resection of motor nerves (Stoffel, 6).

The problem may be attacked at any point in the reflex arc as sensory nerve, motor nerve, muscle, or toward removing the cause of the lesion itself as intimated above in the decompression operation. Tenotomies and tendon transplantations, which have been used for years and which still have their places, are directed toward the muscle. Tenotomy is used most successfully when applied to the Achilles tendon, hamstrings, and adductors; tendon transplantation, by transplanting either the outer or inner hamstrings, preferably the biceps, and Tubby's operation of transplanting the pronator radii teres.

Relapse has been the rule in our experience with simple tenotomy in any except the mild cases, and in these there is no actual shortening as demonstrated by full relaxation under general anæsthesia. Three cases, 1, 20, 21, had had tenotomies previously, but all relapsed within a year. The necessary mental co-operation and application of effort required after tendon transplantation makes this operation useful only in those patients who have a good mentality. A spastic muscle transplanted still remains spastic.

Resection of the posterior nerve roots means a laminectomy. The mortality is high, 7 to 15 per cent, and the operation is difficult technically. The convalescence is long. Sensory, rectal and bladder disturbances are troublesome. It is applicable only to the severest generalized types.

Cranial decompression is limited to those cases in which the spasticity is due to an increased intracranial pressure, and is, therefore, not indicated in a majority of cases. One would hardly recommend decompression in one of the less severe cases in which the mentality is good, and in which the spasticity is not generalized.

I have had no experience or have made no observations with the alcohol injection of the peripheral nerves or with the intraperineural neurotomy. The objection that occurs is that the results of these procedures are only temporary.

The Stoffel operation appeals because of—

1. Its simplicity;
2. The exact dosage is possible;
3. There is less likelihood of a recurrence of the contracture;
4. There is no resulting disturbance of sensation.

In 1910, Stoffel demonstrated that the peripheral nerves have a cable-like structure or nerve pattern, and that the funiculi or nerve bundles making up the nerve always bear the same relation to one another. Each bundle supplies motor fibers to a very definite portion of muscle. The muscle is made up of several parts and the energy produced is the aggregate of these parts. To lessen the aggregate we need only reduce the number of the parts. To isolate the parts, the terminal motor nerves can be divided as they enter the muscle. This is impracticable in some locations as in the large group of muscles in the forearm, while it is possible in others as the gastrocnemius, where the branch breaks up into its several bundles in an easily accessible place before they enter the muscle. With a knowledge of the anatomical relations within the main nerve trunk this can be exposed anywhere along its course, the bundles

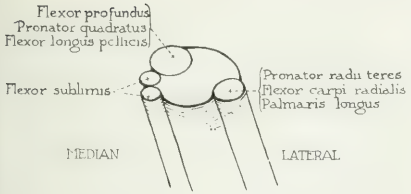

Fig. 1. Topography of the cross-section of the median nerve. Diagrammatic.

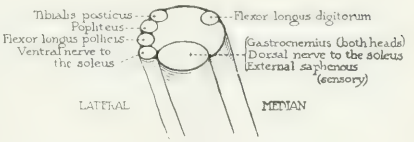

Fig. 2. Topography of the cross-section of the internal popliteal nerve. Diagrammatic.

isolated, stimulated with an electric current as a check, and a portion resected. Those parts of the muscle supplied by the resected bundle become paralytic; the others remain spastic as before. The muscle is weakened, and, theoretically, if the correct number of nerve fibers is resected, equilibrium is restored. Needless to say one must be familiar with the nerve pattern before operation is attempted, and plan the operation from a study of the degree of spasticity present. The opinion of just what bundles to resect, and how much of them to resect, is based only on past experience. Variations in the internal topography of the nerve are so slight that once this knowledge is obtained the electrical current may be dispensed with, but held in reserve for a possible case of doubt.

We have operated on the median, sciatic, obturator, and internal popliteal nerves. For the technique of the operation I would refer the reader to the excellent drawings in Vulpius and Stoffel, the description by Stoffel in the *American Journal of Orthopedic Surgery*, May, 1913, x, No. 4, and by Gill in the *Journal of Orthopedic Surgery*, February, 1921.

For the pronation contracture of the forearm and the flexion contracture of the wrist, fingers, and thumb, the median nerve is exposed just above the bend of the elbow. About 2 inches of the bundle supplying the pronator radii teres, flexor carpi radialis, and the palmaris longus are resected. We usually resect the entire nerve supply to the flexor sublimis digitorum muscle leaving the flexion of the fingers to be performed by the profundus which is inserted into the distal phalanx. One-third to one-half of the nerve supply to the flexor longus pollicis is resected, depending on the severity of the spasticity of the thumb. We have had no case in which it was found necessary to resect a portion of the bundles to the profundus muscle, although this may be necessary in the most severe cases. The medial half of this muscle inserting into the ring and little fingers is supplied by the ulnar nerve, and, of course, these bundles would be resected by operating on the ulnar. As in contractures in the lower extremities I believe it is best to err on the safe side, doing too little rather than too much, as more can be done at a later operation if necessary. It takes only a short time, is easily done, and there is a minimum handling of tissues entailing no shock.

For spastic adductors of the thighs, the obturator nerve is exposed by an incision from the pubic spine extending downward along the adductor longus tendon. No difficulty has been found in obtaining a good exposure of both branches of the nerve through this incision. The adductor longus tendon is retracted outward exposing the anterior branch. The posterior branch is readily exposed under the adductor brevis by retracting this muscle outward and upward. This method of exposure of the posterior branch obviously is easier than following the anterior branch up to the obturator foramen. The anterior branch supplies the gracilis, the adductor longus, and adductor brevis muscles. In moderately severe cases resection of the anterior branch is sufficient, but in more severe cases both the anterior and posterior branches are resected. In two cases in which only the anterior branch was resected it was found necessary later to resect the posterior branch in addition. The posterior branch supplies the obturator externus, the adductor magnus, and sometimes the adductor brevis

muscles. The adductor magnus receives a double nerve supply; those fibers arising from the pubic arch are supplied by the obturator, while that part arising from the ischial tuberosity are supplied by the sciatic. The pectineus and hamstrings, supplied by the anterior crural, also aid in adduction. Thus, when both branches of the obturator are resected, there still remains a considerable degree of voluntary adduction.

To relieve spasticity of the hamstrings, the sciatic nerve is exposed by an incision beginning at the gluteal fold and running downward. For moderately severe contractures the bundle supplying the long head of the biceps and that supplying the semimembranosis are resected. In severe cases, approximately one-third of the bundle to the semitendinosis is also resected. Therefore, there remain intact on the lateral side the short head of the biceps and either all or a part of the semitendinosis on the inner side. These two spastic muscles are sufficient to maintain active flexion of the knee, but their united energy is not sufficient to overcome the extensors of the leg.

To overcome spastic equinus, the internal popliteal nerve is exposed in the popliteal space. It is the most superficial structure in the popliteal space, and the artery and vein are not seen. In moderately severe cases we resect the bundles to the outer and inner heads of the gastrocnemius; in more severe cases one-half of the dorsal nerve to the soleus is also excised. In very severe cases this entire bundle is resected leaving plantar flexion of the foot to be performed by the ventral portion of the soleus, the tibialis posticus, and the flexor longus muscles to the toes. In none of these cases has it been found necessary to weaken the flexor longus digitorum because of a varus.

Spastic contractures disappear under deep anæsthesia, while atrophic contractures do not. If it is found at the time of operation that the contracture persists, we know that structural shortening exists, and it is necessary to lengthen the tendon. This was found necessary in four cases of a severe atrophic contracture in which the foot could not be dorsiflexed to a right angle.

Immediately after operation the extremity is fixed in overcorrection, stretching the spastic muscles and relaxing the antagonists. In pronation contracture of the forearm, the cast is applied in complete supination; the contracted fingers, thumb, and wrist are held in hyperextension. It is frequently surprising to note the increased amount of power developed in the antagonists after relaxation for 4 weeks. After operation on the obturators, the thighs are held in extreme abduction; similarly, the knees in extension, and the feet in dorsal flexion. The casts are removed at the end of 2 to 6 weeks depending on the degree of weakness of the antagonistic muscles, and massage and muscle training are received. The patient is immediately encouraged to walk without apparatus. Our experience is that of Gill (7) in regard to the after-care of the upper extremity. It has been found necessary to hold the forearm and fingers in overcorrection for a much longer time than the lower extremity. The cast is bivalved and the posterior half removed in order that the hand may be removed frequently for treatments. The length of time this splint is continued varies with the progress of the individual case. The mere act of walking, or being able to stand with no contractures does not require the extraordinary degree of co-ordination necessary in the complex use of the hand. For that reason, I believe, the results are not so uniformly good in the upper extremity as in the lower. The pronator contracture is readily overcome and good functional results are obtained in active pronation and supination, but in comparison the results obtained in the complicated use of the fingers and thumb are not so good.

The operation is most suitable in those spastic contractures which are localized in definite muscle groups. It is not indicated in cases showing a diffuse spasm of the whole extremity as in the severest cases of Little's disease. In these cases the Foerster operation as advocated by Blahd and Stern (8), or perhaps the decompression operation of Sharp, may be worth while. There is no indication for its use in athetosis, and, of course, should not be used in any progressive disease. It is contra indicated in the hopeless idiot who

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3. Case 4. Showing result after a spastic equinus.
Fig. 4. Case 6. Showing result after a spastic equinus.

Fig. 5. Case 7. Result after operation on the obturator and internal popliteals.

would never be able to walk even though contractures were relieved. At least a fairly good degree of intelligence should be had in order to obtain a good result in the upper extremity, for reasons mentioned above.

CONCLUSIONS

From the results obtained by the Stoffel operation in 24 cases, I believe the spastic contractures of the adductors and spastic equinus can be absolutely relieved. We have operated on only two cases of contracture of the hamstrings, and the number is not sufficient to draw conclusions on these. However, in one of these recurrence had occurred after tenotomies, and, at present, one year after the Stoffel operation, there is no tendency toward contracture. While spastic contracture of the fingers and thumb can be relieved, the ultimate function of the hand is not so encouraging as in the lower extremity. Perhaps a sufficient length of time has not elapsed in these cases to obtain the maximum result. This, I believe, is not the fault of the operation itself, but is due to the nature of the extreme complexity of motions required in the normal hand.

CASE REPORTS

Case 1. M. S., age 13. Spastic paraplegia. Could not stand without support. Severe contracture of the adductors and hamstrings. Subcutaneous tenotomy of the adductors and open tenotomy of the hamstrings were done on July 12, 1921. She returned the following December with the contractures as before. Stoffel operation was done on both sciatic nerves on December 14, 1921. The next day it was observed that the knees could voluntarily be completely extended, and there was no spasticity of the hamstrings. Stoffel operation on the anterior branch of both obturators was done on May 10, 1922.

This patient was last seen in November, 1922, and had an almost complete range of voluntary abduction of both thighs, and complete extension of both knees. She was able to stand and walk a short distance with no support, and fairly well with braces applied because of weak quadriceps. A letter from the father says he is "well pleased." Result good.

Case 2. C. L., age 8. Spastic hemiplegia. Moderately severe spastic equinus and slight contracture of the forearm in pronation. Transplantation of the pronator radii teres on January 25, 1922, and Stoffel operation on the internal popliteal on February 22, 1922. The nerves to both heads of the gastrocnemius were resected. He was last examined in July, 1922, when the foot could be actively dorsiflexed beyond a right angle. There was only a very slight limp. Result excellent.

Fig. 6. Case 9. Result after operation on the median nerve for contracture of the forearm, wrist, and fingers.

Case 3. G. S., age 14. Spastic hemiplegia. There was a very severe spastic equinus, and only slight power in the extensors of the toes. Stoffel operation was done on February 22, 1922, when the nerves to both heads of the gastrocnemius together with one-half of the dorsal nerve to the soleus were resected. Under deep anæsthesia the foot could not be dorsiflexed to a right angle. A tenotomy of the Achilles tendon was done.

This patient now walks flat on the sole and has good active dorsiflexion. Result excellent.

Case 4. Z. L., age 4. Spastic hemiplegia. Disability in the arm slight. Has been receiving physiotherapy for 2 years. Walked on toes, and foot could not be dorsiflexed to a right angle. On February 25, 1922, the nerves to both heads of the gastrocnemius were resected. This child is still under observation, and on studying her gait it is impossible to tell which side was operated on. Result excellent.

Case 5. D. T., age 4. Spastic hemiplegia. Had been receiving physiotherapy for 1 year. Very severe spastic equinus. On February 28, 1922, the nerves to both heads of the gastrocnemius and one-half of the dorsal nerve to the soleus were resected. The Achilles tendon was lengthened subcutaneously. She now walks flat on the sole and has only a very slight limp. Result excellent.

Case 6. K. N., age 4. Spastic hemiplegia. Had been receiving physiotheraphy 18 months. Walked on toes, and heel could not be made to touch the floor. Stoffel operation on February 28, 1922, when the nerves to both heads of the gastrocnemius were resected. This child is still under observation. There is only the slightest perceptible limp. The foot can be dorsiflexed beyond a right angle. Result excellent.

Case 7. G. M., age 12. Spastic paraplegia. Walked high up on the toes and with the knees in close apposition. On March 1, 1922, the nerves to both heads of the gastrocnemius and one-half of the dorsal nerve to the soleus were resected on both sides. On May 22 the anterior branch of each obturator nerve was resected. When last examined, in August, 1922, he walked flat on the soles, and had an almost complete range of voluntary abduction of the thighs. Result excellent.

Fig. 7. Case 10. Result after operation on the obturators and internal popliteals

Case 8. H. S., age 21. Spastic hemiplegia resulting from an acute endocarditis in 1918. There was a very severe spastic contracture of the forearm in pronation, and flexion contracture of the wrist, fingers, and thumb. Stoffel operation on the median nerve on March 14, 1922. The bundle to the pronator radii teres, flexor carpi radialis and the palmaris longus, and the bundles to the flexor sublimis digitorum were excised. He was last examined in September, 1922, and had complete relief of the pronation contracture. The function of the fingers was decidedly improved. Result fair.

Case 9. S. T., age 13. Spastic monoplegia. There was a very severe spastic contracture of the forearm, wrist, and fingers. Stoffel operation on the median nerve on March 8, 1922. He was last examined in September, 1922, and had complete range of voluntary supination and almost complete extension of the fingers. There was good active power in flexion of the fingers. Result excellent.

Case 10. G. S., age 9. Spastic paraplegia. Walked on toes and had a tendency to cross his knees. Stoffel operation on the anterior branch of both obturators on May 31, and on both internal popliteals on June 28, 1922. He is now able to walk flat on the soles and can keep his knees well separated. Result excellent.

Case 11. E. S., age 6. Spastic paraplegia. There was a rather severe bilateral equinus. Stoffel operation on both internal popliteal nerves on June 8, 1922. The nerves to both heads of the gastrocnemius and one-third of the dorsal nerve to the soleus were resected. A letter from the father in November states that the child walks flat on the soles and that he considers the operation very successful. Result excellent.

Fig. 8. Case 12 Result after operation on the obturator and internal popliteals.

Case 12. B. E., age 7. Hereditary spastic paraplegia. This child, examined with his brother, Case 13, had a very severe spastic contracture of the calf muscles and adductors. The condition in both children had been noted soon after birth. The mother and grandmother were present at the examination and it was observed that both had spastic contractures of the calf muscles. Stoffel operation on the anterior branch of both obturator nerves on July 26, 1922, and the nerves to both heads of the gastrocnemii on June 14, 1922. He was examined on December 6, 1922, and had practically no disability in walking. Result excellent.

Case 13. S. E., age 9. Hereditary spastic paraplegia. Brother of Case 12. Very severe spastic contracture of the adductors and calf muscles. When he was 3 years of age he received an extensive burn over the left popliteal space, and the contracted scar did not permit extension of the knee beyond 135 degrees. Scar excision and Stoffel operation on the internal popliteals on June 14, and resection on the anterior branch of the obturators on July 26, 1922. A very good result was obtained in the relief of the spastic calf muscles, but there still remained difficulty in abducting the thighs. Accordingly, on October 11, 1922, the posterior branches of the obturators were resected. He was last examined on December 6, 1922, and while the spastic contractures had been relieved, he could not walk as well as his brother. Result good.

Case 14. H. C., age 8. Spastic hemiplegia. Stoffel operation on the internal popliteal on June 24, 1922. There was a severe atrophic contracture of the Achilles tendon, and this was tenotomized. A transplantation of the pronator radii teres was done on July 12. She was last examined in November, 1922, and had an excellent result.

Case 15. L. L., age 3. Spastic paraplegia. Child had never walked and was unable to stand alone. When supported he stood high up on the toes and crossed his knees. Stoffel operation on the anterior branch of both obturators and the nerves to both heads of the gastrocnemii on July 11, 1922. Six weeks after operation the child was able to walk across the room with no support and there appeared to be absolutely no evidence of spasticity of the muscles operated on. Result excellent.

Fig. 9 (at left). Case 17. Spastic hemiplegia before operation. The position of the hand, forearm, and foot are typical.

Fig. 10. Case 17. After operation. The heel is on the floor. The forearm is midway between pronation and supination, and the ability to grasp objects is shown by her holding a book.

Case 16. J. B., age 3. Spastic paraplegia. Had never walked or stood alone. When supported stood high up on his toes and crossed his knees. Stoffel operation on the anterior branch of the right obturator and on both the anterior and posterior branches of the left obturator on July 15, 1922. Nerves to both heads of the gastrocnemii were resected at the same operation. While the spasticity is relieved, the child is not yet able to take more than a few steps alone. When he is led there is no tendency to walk on his toes or cross his knees. Greater abduction is possible in the left thigh. Result good.

Case 17. P. J., age 3. Spastic hemiplegia. Did not walk until 26 months of age. Moderately severe contracture of the calf muscles, and of the forearm, wrist, and fingers. Stoffel operation on the median and internal popliteal nerves on July 25, 1922. This child was last examined in September, 1922. A very good result in the leg had been obtained. The pronation spasticity was almost completely relieved

and there was a marked improvement in the use of the fingers. Result good.

Case 18. C. C., age 7. Spastic hemiplegia. There was a most severe contracture of the forearm and hand. Only slight disability in the leg. At operation on August 24, 1922, the median nerve was found to be atrophic and only about one-half the normal diameter. The bundle to the pronator radii teres was identified and resected without difficulty; but even with the aid of electrical stimulation the other bundles could not be satisfactorily isolated. This child is still under observation and has little remaining spasticity of the pronators. There has been no improvement in the use of the hand. Result poor.

Case 19. H. L., age 9. Spastic hemiplegia. Most severe contracture of the forearm and hand. Stoffel operation on September 21, 1922. The bundle to the pronator radii teres, flexor carpi radialis and palmaris longus was resected together with those to the flexor sublimis digitorum. This child is still under observation, and here again we have practically complete relief of the pronation contracture. She is able almost completely to extend the fingers and has a fairly good grip. With further muscle training a very useful hand is expected. Result good.

Case 20. L. M., age 14. Spastic hemiplegia. Most severe contracture of the forearm in pronation and the fingers and wrist in flexion. The heel could not be brought closer than 5 inches from the floor. She had had two tenotomies of the Achilles tendon done previously at another hospital, but they were unable to prevent the contracture from recurring. Stoffel operation on the median and internal popliteal nerves on September 21, 1922. Even after a tenotomy on the Achilles tendon the foot could not be brought to a right angle. After operation an apparatus gradually to force the foot in dorsal flexion was applied. She is still under observation and is able to walk flat on the sole. The spasticity of the pronators has been relieved, and there is a marked improvement in the use of the hand. She will improve still more with muscle training and massage. Result on leg is good; that on hand is fair.

Case 21. L. T., age 20. Spastic paraplegia. Had tenotomies of the adductors and Achilles tendons 1 year before. The contractures returned and she walked with great difficulty high up on the toes, crossing the knees. Stoffel operation on November 22, 1922. Both branches of both obturator nerves were resected; also the nerves to both heads of the gastrocnemii and one-half of the dorsal nerve to the solei. Only 6 weeks have elapsed since operation, but there is every indication of a satisfactory result.

Case 22. M. C., age 16. Spastic paraplegia. Difficulty in walking because of moderately severe spastic adductors and calf muscles. Stoffel operation on November 11, 1922. Resection of the anterior branch of both obturators, nerves to both heads of the gastrocnemii, and one-half of the dorsal nerve to the solei. A sufficient length of time has not elapsed to report on the result.

Case 23. G. C., age 3. Spastic paraplegia. Had never walked or stood alone. Stoffel operation on the obturators and internal popliteals on December 11, 1922.

Case 24. H. B., age 4. Spastic paraplegia. Had never walked. Stoffel operation on the obturators and internal popliteals on December 13, 1922.

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ANALYSIS OF MY END-RESULTS IN THYROID SURGERY[1]

By CHARLES A. PORTER, M.D., F.A.C.S., Boston

THIS series commenced in 1904 and includes all of my cases wherever operated upon. I have not analyzed my non-toxic goiters, so will only state that in more than 250 of these cases only one death occurred, a woman of 67, with a very large goiter of 40 years' duration, who died of pneumonia and hæmorrhagic nephritis 3 days later. Some of the operations have, of course, been difficult and bloody, with occasional alarming cyanosis. To my surprise, there has been no severe secondary hæmorrhage. Of the important complication, injuries to the recurrent nerves, I shall speak later. As is well known, it is most important to examine the larynx before operation, as a previous injury to one nerve may determine extra care in preserving the one on the other side. Many patients are hoarse for a varying time after operation, and in a few weeks or months recover a practically normal voice. This is no proof whatever that a nerve injury has not occurred, for it is the rule that the other cord compensates the function. *Nothing excludes a nerve injury but a thorough examination of the larynx.*

More frequently there have been a few cases of infection in drained than in undrained wounds, the infection varying from bloody serum under the line of incision to definite infection, sometimes developing 2 weeks or a month after discharge from the hospital. Local anæsthesia has seemed somewhat to predispose to such infection, particularly in the slight operation of superior thyroid ligation. Where drainage through the middle of the incision is used and infection occurs, there often results a puckered scar, moving with deglutition. I prefer deep drainage through the ends of the incision, with a small superficial drain, in the midline, outside the sutured prethyroid muscles. The incision must be in the line of cleavage of the skin, and may extend, if more room is needed, far back on both sides, but should never run obliquely or vertically upward, or the scar will spread or become hypertrophied. I prefer fine silk for sutures. Stitches, always loosely tied should be removed on the third or fourth day If in haste, skin clips are useful.

MALIGNANT DISEASE OF THE THYROID

From 1909 to 1920 there were 19 cases; 4 were classified as sarcoma and 15 as carcinoma.

MALIGNANT LYMPHOMA

Case 1. A case of malignant lymphoma, a woman of 48; duration 1 year, tumor hard; stenosis of the trachea; biopsy report was lymphoma or syphilis. Wassermann negative. October 23, 1911, subtotal thyroidectomy; uninvolved right upper pole was not removed; left abductor paralysis. Pathological report: Malignant lymphoma. The present diagnosis is chronic infectious thyroiditis, infiltrating the muscles. In April, 1922, she is in perfect health; no recurrence; still somewhat hoarse.

MIXED-CELLED SARCOMA—THREE CASES

Case 2. A woman of 36; 14 years' duration; recent rapid increase suggesting hæmorrhage into a cyst. Operation, December 21, 1912; tumor the size of a baseball, partly cystic and encapsulated, removed; drainage. Pathological report: sarcoma. Home in 2 weeks. Slight hæmorrhages; continued capillary bleeding in spite of packing. Death, February 18, 1913.

Case 3. A man of 65, duration 2 years; rapid growth for 3 months. Large tumor, fixed; can only speak in a whisper. Operation, January 2, 1913, local and ether. Soft tumors thoroughly removed from both sides of the trachea with left internal jugular vein; actual cautery used. Pathological report: sarcoma, January 3, tracheotomy for dyspnœa. Death, January 11, from purulent bronchitis and exhaustion.

Case 4. A woman of 54; duration 2 months; two X-ray treatments; severe pain; large, very tender tumor of the left lobe; left recurrent paralysis; some fever. Operation, December 31, 1915, gas and oxygen; left hemithyroidectomy with removal of lymph glands; veins thrombosed; tumor size of a lemon; diagnosis was large, round-celled sarcoma. Wound later showed infection. Death, January 16, 1916.

The remaining 15 cases were all classified as papillary adenocarcinoma or adenocarcinoma.

Case 5. Man of 25; duration 1 year, gradually increasing bilateral tumor of the thyroid, with glands in the posterior cervical triangles and both

[1] Read before the American Surgical Association, May 2, 1922.

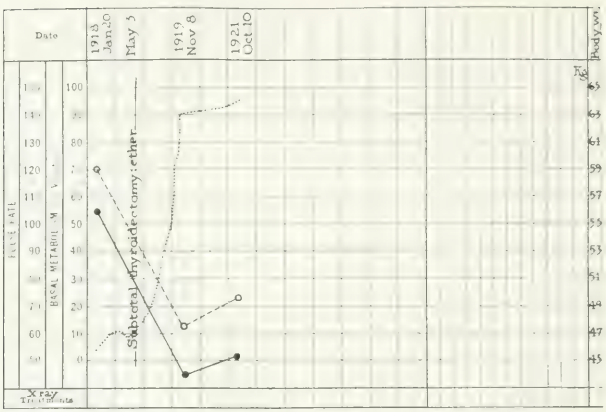

Chart 1. L. T. Female, age, 35. Duration 1 year and 2 months. Graves' disease.

axillæ. Operation, March 11, 1911; much thyroid tissue and many lymph glands removed with the internal jugular vein. Pathological report: adenocarcinoma with necrosis. Discharged in 5 days; wound healed. Readmission, December 29, 1911, for steadily increasing dyspnœa and recurrence of growth; difficult tracheotomy through cancerous tissue. Frequent hæmorrhages; death in 3 months from repeated hæmorrhages and exhaustion.

Case 6. Man of 65; duration 10 months; for the last 2 months increasing dyspnœa; large mass on the left, adherent to trachea and larynx. Trachea pressed to the right. Operation, July 24, 1913, local anæsthesia. Isthmus isolated with mattress stitches, then incised, and trachea opened. Polypoid mass bobbing up and down in the trachea removed; tracheotomy tube inserted and much of the left lobe of the gland removed. Growth found, however, to encircle the trachea. Two days later, leakage of milk; larger tube inserted followed by two hæmorrhages; controlled by packing. Pathological report: adenocarcinoma. Death in 5 days from purulent bronchitis.

Case 7. Dentist of 41, operated upon 5 months previously by another surgeon for supposed adenoma of 1 year's duration. This was later reported cancer. Hard mass with glands on the right; persistent sinuses. Operation, August 24, 1918, under novocaine; mass of glands, probably malignant, extending down to the mediastinum, removed. Pathological report: tuberculosis. From August 27 to October 16 was given four X-ray treatments, involvement of œsophagus, obviously by cancer. November 14, 1918, gastrostomy; hæmorrhage from the neck wound; tracheal fistula. Death, November 18. This case was recurrent cancer of the thyroid with tuberculous glands.

It is very doubtful if operations in Cases 6 and 7 were worth while. These two tracheotomies, followed by death, one 5 days and one 3 months after operation, with repeated hæmorrhages, raise the question of the best treatment in such cases. This must depend on the surgeon's and the patient's point of view.

In Case 7 the only hope of cure was lost unless operation had been done immediately upon the change in diagnosis from adenoma to carcinoma. The patient received no benefit from my partial operation, and gastrostomy, done at his request, was too quickly followed by death from hæmorrhage to be worth while.

Case 8. Codman Hospital. Woman 67; duration 6 years; right lobe increasing in the last month to the size of an orange; dysphagia. Operation, August 24, 1912; growth adherent to the carotid artery and pneumogastric nerve carefully removed with internal jugular; remaining tissues lightly touched with the actual cautery. Would soundly healed in 15 days. Pathology: adenocarcinoma. One week after discharge the growth recurred with frightful rapidity. Death 3 weeks after discharge.

Case 9. Woman of 44; duration 28 years; rapid increase of growth in the last 8 months, involving the whole left lobe and adjacent lymph glands. Trachea displaced to the right, causing dyspnœa. X-ray examination raised the question of metastasis in the fourth cervical vertebra. Report of biopsy: adenocarcinoma. Operation, September 27,

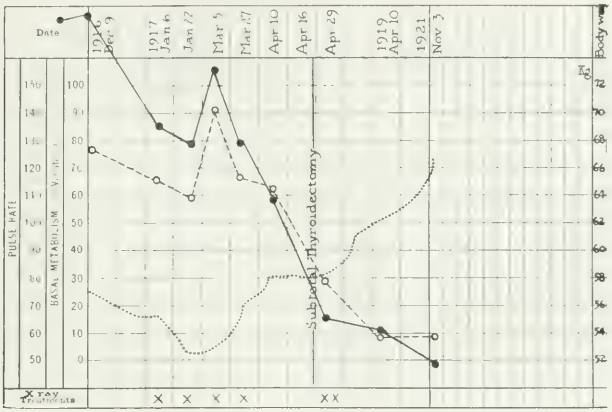

Chart 2. M. M., female, age 21. Duration 1 year. Graves' disease.

1916: whole left lobe and isthmus removed as well as encapsulated mass from the superior mediastinum; radical, clean dissection. Discharged; wound healed in 3 weeks. Died three weeks later.

Neither Case 8 nor case 9 lived long enough to justify such radical and difficult operations.

Case 10. Woman of 50; recent rapid growth of tumor of the left lobe which had been present for 7 years; no hoarseness; some dyspnœa; growth intimately adherent to the tracheal rings. Operation, November 16, 1911; tumor removed with the internal jugular and œsophageal muscles down to the mucosa. Œsophageal muscles sutured with catgut. Discharged, healed, in 2 weeks. Recurrence at the end of 1 year. In this case the operation was certainly justified. Date of death unknown.

Case 11. Woman of 52; Dr. Sheehan, Worcester Hospital; duration 2 years; increasing slowly in size with marked dysphagia and hoarseness for 6 weeks; great pain and loss of weight. Operation, July 24, 1917; very radical operation; complete relief for 6 months; gradual recurrence and death 1 year after operation. For 6 months this patient had complete relief from pain and dysphagia. It seems as though this operation was justified.

Case 12. Woman of 60; for 9 months there was steady growth of the left lobe. Operation elsewhere, April 16, 1918. Malignant mass encircled trachea and had been considered inoperable. Examination of specimen showed adenocarcinoma. Slow but steady growth, without symptoms, until 2 months before operation, which took place September 10, 1920, for a tumor the size of a lemon, adherent to the skin. At operation, under local anæsthesia, a radical subtotal thyroidectomy was done, although some of the cancer was left adherent to the left side of the trachea. Discharged in 10 days. Five X-ray treatments without effect. Ten months after operation the patient developed great dyspnœa, especially at night, with severe coughing and hoarseness. Bilateral abductor paralysis. Patient improved; advised to go home and to return if the symptoms became more severe. Death occurred 11 months after operation.

This case shows cancer of the thyroid, progressing slowly for 2 years, without symptoms. Had a more radical operation been done at first, followed by a thorough X-ray treatment, a cure might have resulted. The patient was relieved from a big tumor which probably would have ulcerated. This palliative operation was, I think, wise.

After this gloomy history of 12 cases, with the first as an exception, there remain 7 in which, although some of the operations were extremely radical, the results have shown that surgery and X-ray treatment were clearly justified, and 3 cases are now living and perfectly well.

Case 13. Man of 66, who had a cyst removed from the left lobe in 1908, reported again in December, 1916, with a solid tumor under the scar, firmly fixed to the deep tissues, and with three small subcutaneous nodules. Operation, December 15, 1916, under novocaine; very radical operation with the excision of nodules performed; tumor extended deeply behind the clavicle. Diagnosis: adenocar-

Fig. 1.

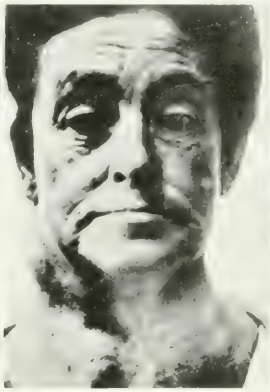

Fig. 2.

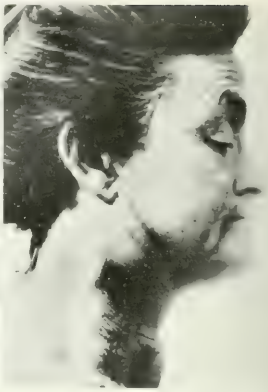

Fig. 3.

Fig. 1. Case 15. Cancer of the thyroid. Photograph December, 1916. Recurrence 2 years and 5 months after first operation.

Fig. 2. Case 15. Recurrence after second operation. Photograph April 23, 1917.

Fig. 3. Case 15. After second operation, April 23, 1917.

cinoma. Discharged in 17 days. Twelve X-ray treatments from January 16 to October 10, 1917. Death from recurrence 23 months after operation.

Case 14. Woman of 60; for 10 years had a tumor on the right side of the neck; has had three separate infections with increase of the growth and then retrogression. Examination showed a very large tumor, lobulated, and in part cystic, involving the right side and front of the neck, extending over and adherent to the sternum, as far as the third rib; very many tortuous and much dilated veins; external jugular over an inch in diameter. Diagnosis: adenocarcinoma of the right lobe with infection. Operation, March 5, 1910. With great difficulty, owing to bleeding and adhesions as a result of past infections, the upper and the lower flaps were reflected, leaving the adherent skin attached to the tumor. Sternomastoid muscle cut; with extreme difficulty a tumor, weighing over 5 pounds, with the internal jugular vein, was removed, as well as innumerable malignant glands. Operation lasted one and three-quarter hours, and I consider it one of the most formidable operations I ever did. Pathological report showed, in certain regions, proliferating papilloma, hæmorrhagic cysts and adenocarcinoma. The glands were adenocarcinoma. Uneventful convalescence. Nine months after the operation a recurrence appeared, the size of an apple, adherent to the skin. At the second operation, December 5, 1910, the tumor had infiltrated the lower part of the sternomastoid, extended behind the sternum, was adherent posteriorly to the common carotid and internally to the larynx and trachea and to the outer muscular wall of the œsophagus. By a most laborious dissection the whole mass was safely removed. Again there was an excellent recovery. January 25, 1912, the patient was in good condition. She died, however, of recurrence 3 years after the second operation.

Case 15. Woman of 48 noticed a small lump on the right side of her neck 6 years ago. This tumor steadily increased in size, but with greater rapidity during the last year. There were no symptoms. Examination showed a tumor of the right lobe the

Fig. 4. Fig. 5.

Fig. 4. (Left.) Case 15. Cancer of the thyroid. Photograph March 21, 1918, after fifteen X-ray treatments, begun January 11, 1918.

Fig. 5. Case 15. Cancer of the thyroid. Photograph March 21, 1918, after fifteen X-ray treatments, begun January 11, 1918.

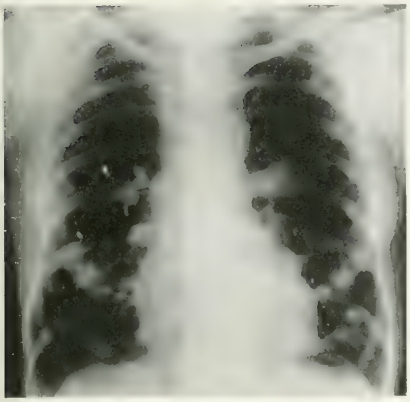

Fig. 6. Case 16. Cancer of the thyroid. Metastatic carcinoma in the chest. Roentgenogram taken August 1, 1917.

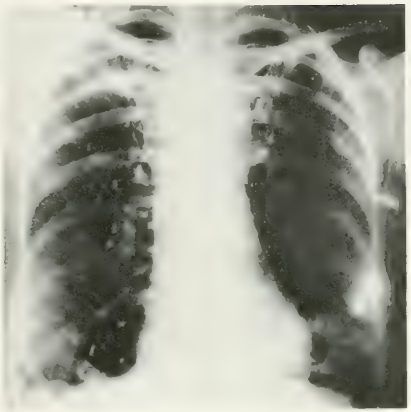

Fig. 7. Case 16. Cancer of the thyroid. Disappearance of lung metastases except in lower right base. Roentgenogram taken September, 1920.

size of an orange; the mass moved with deglutition and was elastic and tense. X-ray of the chest suggested an enlarged thymus or a substernal goiter. The right apex was definitely dull. Otherwise the report was negative. Operation, July 24, 1913; ether anæsthesia. The tumor was encapsulated and easily shelled out without rupture. It was, however, adherent to the laryngeal muscles. Diagnosis: adenocarcinoma. In December, 1916, she reported again. There had been a steadily growing recurrence for the past 2 years. The examination showed multiple cystic tumors involving both sides of the neck, more marked on the right, and pushing the trachea to the left. At this time there was no difficulty in phonation. Numerous tumor masses, slightly adherent to the internal jugular vein, were excised on December 26, 1916. Some of them were fairly well encapsulated. Pathological report: adenocarcinoma. Convalescence excellent. X-ray treatment begun January 11, 1917, by Dr. George Holmes. On March 24, 3 months after the operation, there were recurrences on both sides of the neck, with dullness behind the mediastinum. X-ray treatment pushed. On April 23, 4 months after the operation, the X-ray picture showed round areas, sharply defined, with dense centers scattered through both sides of the chest, quite characteristic of metastatic malignant disease. By February, 1918, all evidence of the disease had disappeared from the neck, except a few small glands in the left supraclavicular region. X-ray treatment continued. On December 23, 1918, 2 years after the operation, the shadows had disappeared from both lungs with the exception of one area in the right costophrenic sinus. On September 9, 1920, a slight induration under the right jaw, which had been present for several months, was growing smaller under X-ray treatment. Both lungs remained clear except for the before-mentioned metastasis at the right base, which had not changed. Her metabolism on October 2, 1920, after thirty-nine X-ray treatments, was minus 21 per cent, though there were no symptoms of myxœdema. The patient was thin, but stated that the cough which had bothered her for several months was considerably better. There was no bloody sputum. The patient died, probably from internal metastasis, at the end of December, 1920, 7½ years after the first operation.

There is no doubt that operation was justified in this case and that the X-ray exerted a remarkable influence on the recurrences and metastases.

Case 16. Woman of 75; for 2 years there was a steady growth of a hard nodular tumor of the left lobe with enlarged glands. The whole mass with the glands was removed with the outer wall of the pharynx, on December 2, 1916. Wound slightly septic. Discharged 10 days after operation. Pathological report: adenocarcinoma. Reported on April 1, 1923, 7 years after operation, perfectly well with no evidence of recurrence.

Case 17. Woman of 46. For 8 years had a tumor in the left lobe of the thyroid which had recently grown larger and pressed the trachea to the right, as shown by the X-ray. The tumor was hard and round and partly intrathoracic; no symptoms. Operation, January 18, 1921; ether anæsthesia. Encapsulated tumor, size of a golf-ball, removed

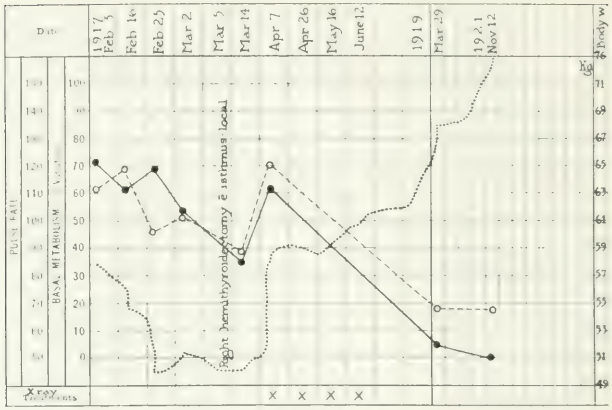

Chart 3. E. B., male, age 35. Duration 5 years. Graves' disease.

unruptured, with some adjacent thyroid tissue. Dr. Wright reported the growth as a carcinoma, but could not determine whether it was from the thyroid or parathyroid. Reported April 22, 1922, perfectly well; no evidence of recurrence; gained 25 pounds.

Case 18. A woman of 74 first noticed a tumor on the right side 2 years ago, which had increased rapidly during the last month. Diagnosis: carcinoma. Operation, November 9, 1918: radical thyroidectomy with wide excision, including the internal jugular vein and right recurrent nerve. Pathological report: adenocarcinoma. Three erythema doses of the X-ray at 3 week intervals followed. Two years afterward she broke a hip in an automobile accident. The fracture united soundly. On April 6, 1923, she was in excellent health, with no evidence of recurrence.

Case 19. A woman of 38; for 3 years steadily increasing growth of a sharply defined tumor in the median line, about the size of a hen's egg, extending down to the sternal notch; tensely fluctuant; no enlargement of the lateral lobes. Operation, February 20, 1913, ether anæsthesia. In the isthmus was an encapsulated tumor firmly adherent to the surrounding structures. As the growth would not shell out it was carefully removed by scissor dissection with adjacent thyroid tissue. Pathological report said: "A portion of the thyroid gland, consisting of the walls of a cyst, with a nodule the size of an English walnut, having a grayish-white section surface. Microscopic examination shows the tumor consisting of an irregular network of fibrous papillæ covered with a single layer of small deeply-staining cells and numerous irregularly-shaped follicles filled with colloid. There are wide bands of fibrous stroma which contain a number of small follicles. Several small lymph nodes adjoin one of these firm fibrous bands, and in them are solid columns of atypical cells. Diagnosis: adenocarcinoma with metastasis in the adjoining lymph nodes.

March: Wound soundly healed. She reported this year, April, 1923, perfectly well, with no evidence of any recurrence 10 years after operation.

In the above cases the age of onset was 1 at 25, 1 at 35, and in the others the growth appeared after 45 years of age. The duration of the tumor previous to operation was in 1, 9 months; in 2, 1 year; in 2, 2 years; in 1, 5 years, and in the remainder from 6 to 28 years. A study of this series and other cases of malignant disease of the thyroid shows two different types: In one the cancer occurs primarily in people beyond middle life, usually as a unilateral, less frequently as a bilateral goiter and grows steadily or rapidly. In the other type the cancer develops in a tumor of long duration, evidenced by a more or less sudden increase in the size or induration, with loss of weight, pressure symptoms, shown by nerve paralysis, or involvement of adjacent tissues or lymphatics. Particularly unfavorable are the cases in which the tumor is fixed to the trachea, with paralysis due to involvement rather than to pressure on the nerve. Favorable for cure are encapsulated adenomata which have undergone malignant degenera-

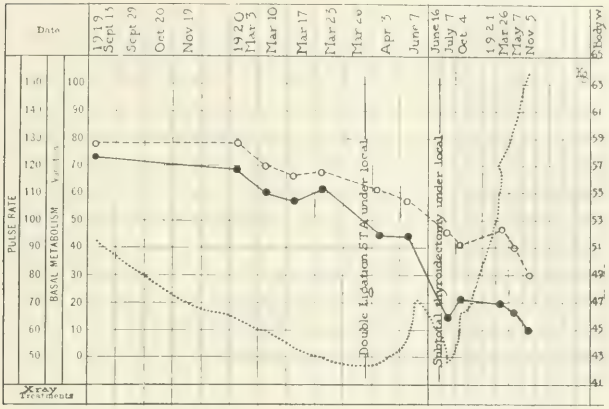

Chart 4. M. R., female, age 31. Duration 2 years. Graves' disease.

tion. The stony hardness of cancer may be simulated by calcification of the walls of cysts. A portion of a doubtful growth or a lymph gland under local anæsthesia may be removed for examination. Even if the report be negative and a reasonable suspicion of cancer in another part of the tumor exists I believe a radical operation should be done, for I have been unable to distinguish any difference in the character or extent of the growth which would aid me in determining that operation would be followed by a rapid recurrence, a long palliation or a permanent cure.

What is the best treatment when the diagnosis of malignancy is almost certain or confirmed by biopsy? Provided a careful X-ray examination of the lungs is negative, I believe a radical operation, although most formidable and exacting, should be attempted whenever it seems probable that all obvious disease can be removed. There is no doubt that general anæsthesia markedly increases the risk of operation in these cases, with the not infrequently attendant dyspnœa, nerve paralyses, and severe hæmorrhages. Under local anæsthesia, which I always prefer, the above objections are lessened, with the decided advantage that operation can be stopped at any time and continued at a subsequent date. If malignant disease must be left behind radium needles may be implanted and intensive X-ray treatment started, even on the afternoon of the same day. I believe a primary clean dissection will often postpone, if not entirely avoid, the need for tracheotomy. Nothing can be more distressing than the plight of late cases, which require an emergency tracheotomy through cancerous tissue, with the usual repeated hæmorrhage, dyspnœa, and pulmonary infections. Inoperable recurrences may be benefited by X-ray treatment, as shown in Case 16, where even the pulmonary metastases, with the exception of one place, apparently disappeared.

Unless my experience is peculiar, cancer of the thyroid is not a very rare disease. Exploration on suspicion seems the only rational procedure. Even if the diagnosis is clear in a majority of the cases, operation offers more in the way of palliation or cure than treatment by X-ray or radium alone.

TOXIC GOITERS

In the early part of this series no proper distinction was made between toxic adenomata and Graves' disease. It is easy to see, as one looks back, many errors of judgment in overoperating, although occasional grave risks were taken deliberately when the patient did not improve under rest and medical treat-

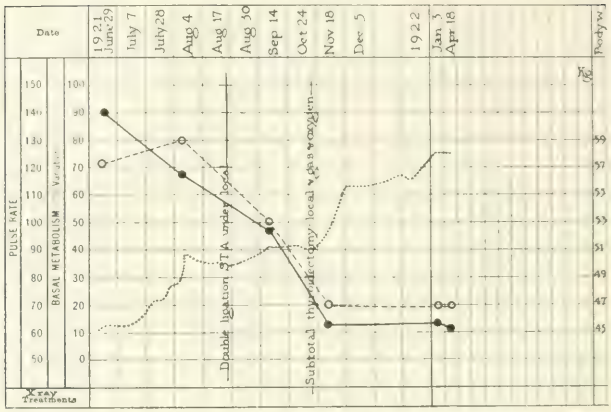

Chart 5. A. F., female, age 52. Duration 5 years. Graves' disease.

ment. The mortality has been steadily diminishing. In the 5 year period from 1904 to 1908 inclusive there was no mortality. From 1909 to 1914, 15 per cent; from 1914 to 1919, 14 per cent; from 1919 to 1920, 8 per cent, and from 1920 to date, January, 1921, 3 per cent. Twenty-six cases have been operated upon since January, 1921, with one death, and are considered, except for the mortality, too recent to analyze. In making up these figures, I have given the mortality by *patient and not by operation*. The total number of cases is 204, and though the series is small in comparison with the larger clinics, I have followed many of them personally for years. My secretary, Miss G., and Miss Burgess have enthusiastically co-operated in the endeavor to get end-results. It has often been difficult to arrange for patients, the majority of whom feel well, to come to the hospital breakfastless or to spend the night previous to a metabolism test.

It is often impossible to estimate the rôle of different factors as causes of death; for unsatisfactory anæsthesia, unexpected loss of blood, a heart already seriously damaged, hyperthyroidism and pulmonary infection may some or all be present in the same case. Occasionally, and particularly under gas and oxygen, patients have stopped breathing and have become cyanotic, but have recovered quickly enough to justify a continuance of the operation. It is now clear to me that when in doubt as to the wisdom of proceeding, the operation should be stopped at whatever stage, and the wound quickly sutured or packed with thin rubber dam or gauze. It is obvious that long, close co-operation between the surgeon and his team will do much to diminish the mortality in doubtful cases.

It has been our custom at the Massachusetts General Hospital, since the thyroid clinic was started with two medical men, a roentgenologist, and two surgeons, to give the roentgenologist, Dr. Holmes, an opportunity to demonstrate the use and limitation of X-ray therapy. Wherever there has been evidence of an enlarged thymus two or three X-ray treatments have been given. Whether radiation of this gland affects the syndrome, status lymphaticus, favorably we do not know, but there is an impression that after such radiation, the operative risk has been improved, although a part of this impression may be due to a lessening of the toxicity from the thyroid. I believe there is no doubt that X-rays improve and will cure certain cases of Graves' disease. Dr. Means and Dr. Holmes have recently reported 44 cases of exophthalmic goiter in which X-ray alone was used. Twenty-eight

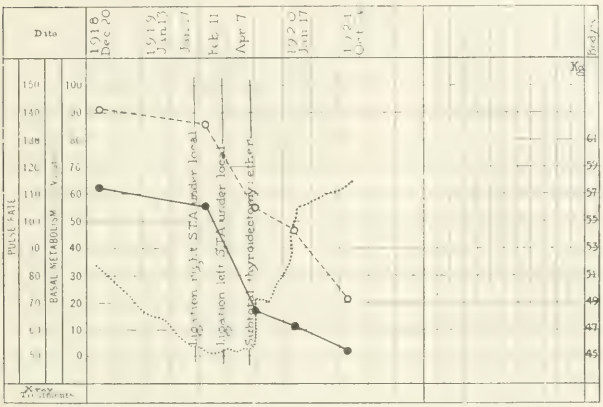

Chart 6. E. P., female, age 22. Duration 8 months. Graves' disease.

of these showed definite improvement, and 13 of this number, judged by a normal basal metabolism, were completely cured. In addition there were 12 toxic adenomata with 5 apparent cures. These cases have been treated during the past 3 years. There are also, in addition, 15 cases, all treated before 1915; 7 of these, examined in the spring of 1922, were apparently cured and are now perfectly well, according to normal metabolism rates. Time, of course, is a considerable factor in these cures, but this also applies to surgery.

After a period of rest, either with or without X-ray therapy, we perform a graded operation, depending upon our judgment, and consisting, as in other clinics, of preliminary ligation or ligations, hemithyroidectomy or subtotal thyroidectomy. It is easy to see my errors of commission in the past. In other words, there was then ignorance as to graded operation and a tendency to do too much.

Of the 204 cases analyzed, there occurred 24 deaths in the hospital and 9 deaths at various periods after discharge. I have divided the hospital deaths into four classes:

1. Hyperthyroidism as possibly preventable with increased knowledge.
2. Pulmonary complications which have been strikingly frequent in comparison with only one death in non-toxic goiter.
3. Cardiac complications.
4. So-called accidental deaths.

There were 13 deaths from hyperthyroidism, more frequent, as was to be expected, early in the series. Three deaths followed ligation under local anæsthesia.

1. In 1913, a man extremely toxic, suicidal, loss of 60 pounds in 6 months; in a dark room for 3 months. Double ligation. Death in 48 hours.

2. A man of 45; decompensated heart; cirrhosis of the liver; drug fiend. In 1911, double ligation. Death in 40 hours.

3. Operation, March 3, 1919, a single superior thyroid ligation upon a man who had lost 37 pounds in 2 months. Pulse-rate 126 and metabolism +85. The hyperthyroidism was slight, but marked acetonuria and glycosuria developed, with an irregular pulse of 80 on the sixth day. There were also nausea and vomiting. In spite of treatment, acetone and diarrhœa persisted, and on March 26, as a desperate resort, ligation on the other side was performed. This time there was marked hyperthyroidism with a pulse of 225. Death occurred on the fifth day.

In the first two cases I might have done a single ligation instead of a double one, but both operations were so easy that I doubt if the extra ligation made much difference. In the third case my only error, if there was any, was in operating at all.

4. A girl of 23 had had Graves' disease for 6 years, which had become severe in the last 6 months. She also had aortic insufficiency, mitral stenosis and

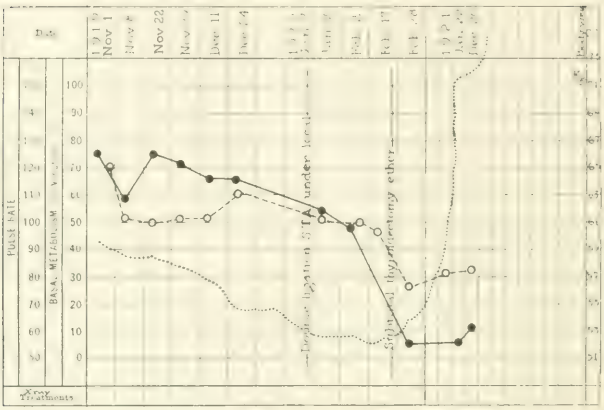

Chart 7. A. H., female, age 42. Duration 2 years. Graves' disease.

insufficiency. Pulse 130; metabolism +90. Rest in bed for almost 5 months and five X-ray treatments improved her condition, and on May 8, 1919, I did a double ligation. There was a moderate reaction. She had 5 months more of rest, and then, under ether, a subtotal thyroidectomy. Death occurred 7 hours after operation from marked hyperthyroidism. The case was complicated by her severe heart disease. The operation should have been limited to a hemithyroidectomy.

This last case was the only one which had preliminary ligation; the other 9 which follow had primary hemithyroidectomy or subtotal thyroidectomy.

5. A girl of 18; duration 7 months; marked toxicity. Right hemithyroidectomy, under ether anæsthesia, in 1910; vessels on the left ligated. Death 36 hours after operation.

6. Woman of 25; duration 8 years; acute symptoms for 4 months; myocarditis. She improved after rest in bed. Operation, under gas and oxygen, September, 1912. Hemithyroidectomy and ligation of vessels on the other side; severe hyperthyroidism; death on the third day.

7. Woman of 30; duration 2½ years; loss of 30 pounds; severe diarrhœa; metabolism, September 26, 1916, +48; pulse 150; metabolism on October 8, +58; pulse 133; loss of 4 pounds while in bed. Local anæsthesia was planned, but owing to the excitement of the patient, gas and oxygen were substituted and a subtotal thyroidectomy was performed, November 3. Typical hyperthyroidism; death 48 hours after operation.

8. Woman of 26; duration of acute symptoms, 9 months; rest in bed at Samaritan Hospital for 3 months, with improvement. Metabolism dropped from +84 to +65. Under ether, March, 1917, right hemithyroidectomy; cyanosis during the operation but condition apparently improved enough to justify the removal of a part of the left lobe. Typical hyperthyroidism; death in twenty-four hours.

9. A girl of 20; duration 5 years with exacerbation for 2 months; metabolism +80; under ether, in 1918, subtotal thyroidectomy; marked hyperthyroidism; death 24 hours after operation. Postmortem examination showed an extremely large thymus and hypertrophy and dilatation of the heart.

An analysis of these 5 cases shows them to be young women from 18 to 30 years of age; 2 were Jewesses with very little self-control; in 4 cases the symptoms were more or less acute for 2 to 9 months. In 1 the symptoms persisted for 2½ years with frequent diarrhœa and corresponding loss of weight. The average metabolism in 3 cases was +68. The first case was operated upon in 1904 and the last in 1918. With our present knowledge it seems clear that, because of the comparatively acute conditions, the relatively high metabolic rate, the nationality of two and the *youth of all*, two hemithyroidectomies with ligation of both vessels on the opposite side and three subtotal thyroidectomies was too radical treatment. At present the probable course would be preliminary ligation, with or without X-rays, and a hemithyroidectomy only instead of any operation on other side.

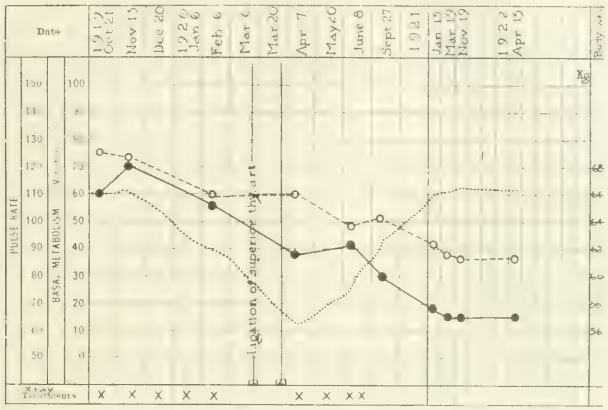

Chart 8. A. B., female, age 23. Duration 3 years. Graves' disease.

There were 3 deaths from hyperthyroidism in women of 40 or over:

10. A woman of 40; duration 1 year; morphinism; marked prostration. On May 6, 1912, under gas and oxygen, right lobectomy with ligation of both vessels on the left; hyperthyroidism well marked with delirium. Morphine in large dosage was probably continued by relatives; pupils markedly contracted. Death 11 days after the operation with terminal pneumonia.

11. A woman of 47; duration 5 years; œdema of legs; irregular heart; loss of eight pounds in 7 weeks; nausea and vomiting. Subtotal thyroidectomy in 1916, under gas and oxygen. Died in 48 hours from hyperthyroidism.

12. A woman of 57; acute symptoms for 8 months; loss of 36 pounds in the last 4 months; mitral insufficiency and auricular fibrillation; treated medically for 3 weeks, during which time she was given digitalis. Metabolism, March 26, 1917, +78; on April 10, +99. Subtotal thyroidectomy under gas and oxygen; unusual hæmorrhage; pulse 140, poor toward end of operation. Death in 7 hours.

Again it seems clear that, in the first case, a thoroughly tired, toxic woman should not have had so much surgery, apart from any question of morphinism. In the second case ligation should certainly have preceded thyroidectomy, which also applies to the third case. The rising metabolic rate should have been an indication for a less severe operation, particularly with the damaged heart.

13. There is one more case, a woman of 50, a Jewess, with high blood pressure and a toxic retrosternal adenoma causing obstruction. The metabolism was +48. Under anæsthol and ether, in June, 1918, a tumor the size of a large lemon, without much difficulty or bleeding, was removed from the right lobe and superior mediastinum. The patient died in 48 hours with high fever and bronchitis. There was some hyperthyroidism, but I do not see how the death could have been avoided, for, because of the nationality of the patient, operation under local anæsthesia would have been impossible.

PULMONARY COMPLICATIONS

There were 6 deaths from pulmonary infection, or at least there were 6 in which pneumonia or bronchitis played the chief rôle. There were 5 cases of death in young people, 2 of whom were 30 years old, 2 were 22, and 1 was 19. Two of these were Jewesses in which hyperthyroidism was also a factor.

1. A girl of 19; duration 1 year; very toxic. Under gas and oxygen a subtotal thyroidectomy was done in 1911. Bronchopneumonia and hyperthyroidism developed shortly after the operation. From the latter she recovered in a few days, but the pneumonia resolved very slowly. She lost her appetite, had considerable dyspnœa, with respirations between 30 and 40. A terrific hot wave intervened, the highest on record, from 104 to 98°, on July 10, 1911. On this day she died of heat prostration. The wound was entirely healed.

2. A girl of 22; duration 3 years; very toxic. A left ligation on October 1, 1913, was performed,

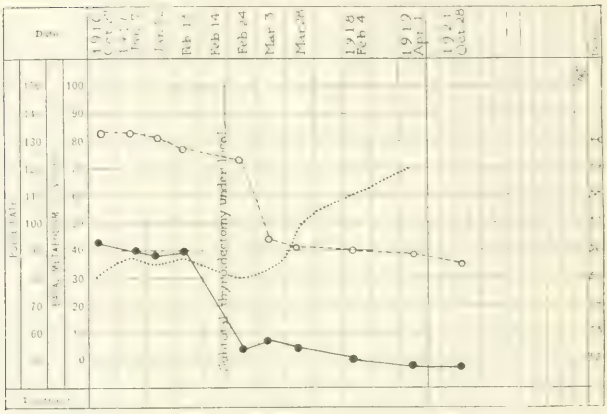

Chart 9. V. B., female, age 37. Duration 1 year. Graves' disease.

and on November 28, 1913, a right ligation. Advised to return for thyroidectomy, but did not report for 2½ years. Metabolism done in January, 1916, was +78, pulse 130. Rest in bed for 1 month, and on March 2, 1916, right hemithyroidectomy, with basting of the left lobe. She was sent back once from the operating room, the preceding week, because of her extreme toxicity. Death on the eleventh day from pneumonia and pericarditis. This patient lost the benefit of ligation because of her long delay in returning for thyroidectomy, contrary to advice.

3. A girl of 22; duration 4 months; rest in bed for 2 weeks. On March 28, 1913, under gas and oxygen, right hemithyroidectomy; death in 3 weeks from bronchopneumonia. Wound well healed.

4. A woman of 30; duration 7 years with thyrotoxicosis intermittently for the same length of time; loss of 35 pounds in 9 months; melancholia; metabolism +81. Right ligation in January, 1915, and 11 days afterward, under gas and oxygen, a left ligation. Patient stopped breathing for a time on the table and was sent back in poor condition. Death 48 hours later. Autopsy showed a clean wound, a very large thymus, purulent pericarditis, and pleuritis. My only criticism of this case is that the use of the X-ray might have reduced the thymus and hyperthyroidism and made her a safer risk. I cannot explain the pericarditis.

5. A woman of 30; duration 2 years; did not improve under medical treatment; mitral systolic murmur. Subtotal thyroidectomy on December 6, 1912; marked hyperthyroidism and pneumonia resulting in death 11 days after operation.

6. A woman of 36; duration 11 years; very toxic; under novocaine, on October 7, 1913, a right ligation was performed, and on the 22d, under gas and oxygen, a right hemithyroidectomy; slight sepsis of the wound; death 5 days later from bronchopneumonia.

FATAL CASE OF TETANY

A girl of 22, with Graves' symptoms for 8 months. On March 11, 1911, under ether, double superior thyroid ligation. In 1 year she had gained 25 pounds and was much better; further operation was advised and refused. She lost weight, 17 pounds in all, and finally returned for operation, October 23, 1914. Operation, October 23, 1914: subtotal thyroidectomy. Pathological examination: intraglandular hypertrophy. Until October 27 her convalescence was uneventful. On this day, at 5:30 p.m., about 78 hours after operation, the attention of the nurse was called to the patient. The thumbs were flexed bilaterally on the palms. She was seen 15 minutes later and then exhibited the usual signs of tetany: flexion of the thumbs on the palms, a sharp flexion of the fingers at the metacarpophalangeal joints, flexion at the wrists with slight flexion of the arms at the elbow and with the arms crossed in front of the body (Chvostek). Tachopnœa of from 40 to 50 per minute. Pulse only slightly elevated to 120. Complete numbness over the arms and neck. Feet in a slight degree of flexion. Could speak only above a whisper.

At 6 p.m., about one-half hour after the onset calcium lactate, grains 30 by mouth. Condition subsided and at 7 p.m., only a slight flexion of the thumbs persisted. Calcium lactate, grains 15, at 7 p.m., and in the next hour she was apparently normal again. Had a good night.

October 27. Good day. Wound clean. Pulse [illegible] Had a good night.

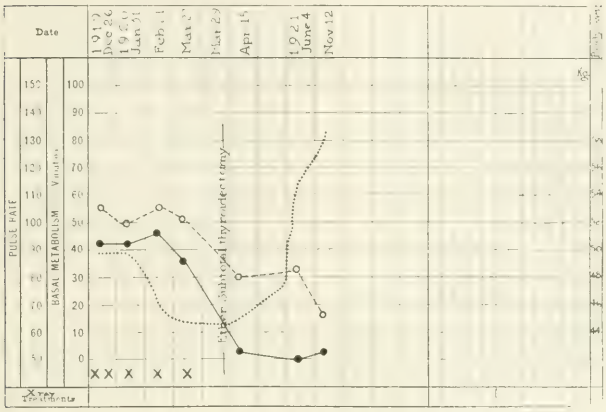

Chart 10. P. R., female, age 29. Duration 3 months. Graves' disease.

October 28. At 7.30 a.m., about 36 hours after the administration of the calcium, there was another attack of tetany, more severe. Tachopnœa from 60 to 70. Slight permanent retraction of the upper lip. Pulse 100. Feet in marked flexion and contractures of the hands more severe. Calcium, grains 15, 2 per cent intravenously. In two hours complete relaxation of the spasm. Put on calcium, grains 60 per day.

October 29. Excellent condition. Pulse 80. Exophthalmos less. Says she feels better than she ever has felt since she had Graves' disease.

November 1. Eating well. Excellent scar. Speaks only in a whisper. Chvostek persists. Slight spasm of the upper lip muscles.

November 6. Chvostek still persists.

November 10. Calcium reduced to grains 40 per day.

November 11. This morning, at 6.15 a.m., another slight attack with flexion of the thumbs, etc., but to a lesser degree. Respirations 30 to 35; pulse 80. Calcium, grains 30. Spasm disappeared save for a spasm of the thumbs. Calcium, grains 15, and by 8 o'clock all spasm was gone. Put on calcium, grains 60, again. White blood cells, 10,800.

November 11. Throat room: complete paralysis of both recurrent laryngeal nerves.

House officer's note. "This last attack shows how narrow is the margin of calcium equilibrium in her case when a drop of only 20 grains of calcium is sufficient to bring on tetany."

November 12. Nerve O. P. D. She has a reaction to induced currents (Paul). She was tired out and a condition of hyperexcitability was found. She reacted to one-fifth part of the stimuli necessary for normal. (Tried on several nurses at the same time.)

November 13. Shown to the Clinical Surgical Society. She was not unduly excited nor was there any rise in pulse.

November 16. Up and about.

November 20. Open ward. Slight Chvostek still. Pulse 70 in the daytime and at night as low as 56. Gaining in weight.

November 22. Headache; slight contraction of both thumbs in the morning. Calcium, grains 15, at 6.15 a.m. Calcium, grains 15, at 6.40 a.m., Spasm disappeared.

November 25. Same. Sore throat. Glands swollen; tonsils reddened. Temperature 102°. Slight attack. Calcium, grains 15, at 8.30, with relief. Is very nervous and cries a great deal.

November 26. Glands in neck larger. Throat red; tonsils swollen. Slight attack in morning. Calcium, grains 15, at 9.30 a.m. Irritable and nervous. Refused to speak to friends who visited her. Slight attacks in evening. Calcium in 2 per cent solution subcutaneously and subpectorally, grains 15 at 11.

House officer's note. "The interesting fact about this is that the acute infection is lowering her ability to assimilate the calcium ingested in some manner, as is shown by the fact that on the uusal 60 grains per day, tetany signs start, where before 60 grains was sufficient to prevent them."

November 27. Mentally irresponsible but physically better.

November 30. Irritable.

December 2. Parathyroid extract, grain $^1/_{20}$ in tablet form. Calcium, grains 40.

December 5. O. K.

December 7. Both cords in cadaveric position. Complete paralysis of both nerves.

December 8. Enormous appetite.

December 10. Calcium reduced to grains 30.

December 13. Sore throat; cervical adenitis; tonsils red. Slight attack. Calcium, grains 30, with relief.

December 16. Parathyroid increased to grain 1/10 three times a day.

December 17. White blood cells, 11,600.

December 20. Has gained 20 pounds since operation. Appearance of myxœdema. Hair dry and brittle; sluggish mentally. Calcium, grains 20.

December 23. Pulse poor and increased in rate. Dr. Lee says weakness of heart muscle; digipuratum.

December 27. Pulse better. No signs of tetany. Mentally irresponsible.

December 30. Better.

January 2, 1915. Went to bed at 6 p.m. Got up at 11 p.m., out of bed, seized the tumbler and pitcher and dashed them both on the floor. She wandered about the ward muttering, violently resisting the nurse. When seen she was in the linen closet, a typical case of acute mania—laughing, picking things from the air, etc. There was no contracture of the muscles and no Chvostek. In a few minutes more she suddenly became rigid, her hands contracted violently, the arms flexed sharply across her chest, accompanied by several generalized, tetanic convulsions. She then became absolutely rigid, ceased to breath, became cyanotic; the feet sharply flexed and the pulse could not be felt. She was laid out on the floor and calcium, grains 20, intravenously given, also 5 per cent solution subcutaneously. She then relaxed and again returned to the state of mania. Very restless all night.

January 3. Same. Knows her name and where she is only. Eating Calcium, grains 60 per day

January 6. Insane; gets up unless watched. Restraint necessary

January 8. Slight attack. Calcium, grains 30. intravenously. Sulphonal helps to quiet and morphine p. r. n. Paraldehyde not effective.

January 8. Violent. Restraining sheet applied. Temperature and pulse rising.

January 10. Talks incessantly. Some retention of urine.

January 13. Quieter and weaker. Death at 8.45 a.m., 2 months and 3 weeks after operation.

In the next 3 cases I have called the deaths accidental.

1. A woman of 20; Hebrew; severe Graves' disease; subtotal thyroidectomy on February 15, 1916. At the end of the third day a large infarct of the left lung occurred and caused death in 2 days.

2. A girl of 23; four X-ray treatments, reducing the metabolism from +77 to +47 in a little over 5 months and the pulse from 153 to 133. Subtotal thyroidectomy, under gas and oxygen, on May 2, 1917; pulmonary embolus with a large infarct of the lung caused death the following day

[illegible] loss of weight, 31 pounds in the last year, in spite of excellent appetite; duration 2 years; metabolism, February 13, 1920, +55. Two X-ray treatments. In March the metabolism was +38; losing more weight; pulse 120. Under rest in bed she gained 22 pounds; pulse 105 and metabolism +40. A subtotal thyroidectomy was performed May 18, 1920, under gas and oxygen. During the operation there was some cyanosis and irregular respirations, but she left the table in fair condition. Was put to bed, when she gave four short gasps and died. Autopsy showed status lymphaticus and a cyst of the pineal gland.

4. A Jewess of 40; menopause; melancholic and suicidal; refused operation on four successive days and finally consented if I would come immediately Under ether, on October 1, 1919, right hemithyroidectomy Owing to the fair condition of the patient after this and to the probability that she would refuse another operation, I removed one-half of the left lobe against my better judgment. The pulse rose rapidly after operation and she died in 2 hours.

Of the 24 deaths in the hospital 13 died of hyperthyroidism, 6 from pneumonia or bronchitis, 2 from pulmonary emboli, 1 from tetany, 1 from status lymphaticus and 1 from shock after a too radical operation upon a suicidal climacteric Jewess.

Nine patients died after discharge from the hospital. One of these, a woman with double ligation in 1916, did not return for further operation, as she was advised, and died from her disease 1 year after discharge. Another woman, with double ligation, died 7 months after discharge, cause unknown. A third died from influenza and pneumonia, during the epidemic, 21 months after discharge. The fourth died 2 years afterward, cause unknown. A fifth was cured of his Graves' disease with a pulse of 72, but was accidentally shot 2 years afterward while deer hunting. A sixth, double ligation, had severe mitral disease After operation she convalesced satisfactorily for 3 weeks, when she suddenly developed a right hemiplegia from an embolus. She lived 3 years afterward. The seventh was a woman of 40, who had had Graves' disease for 21 years and mitral disease for many years, with a dilated, uncompensated heart and auricular fibrillation. A right hemithyroidectomy was done under novocaine as a late palliative operation. She definitely improved but died 4 years later from cardiac decompensation The eighth was a woman of 27; double sepa

rate ligations in May and June, 1920; following the ligations, six X-ray treatments without improvement. In October, 1920, right hemithyroidectomy and removal of the isthmus. In December, 1920, metabolism was +6. In January, with pregnancy, her metabolism rose to +30, with a very slight return of symptoms. She had a normal confinement, but died January 29, 1922, from a pulmonary embolus, 40 days after confinement. The ninth, subtotal thyroidectomy in July, 1918; woman of 43 was cured of Graves' disease, but died in April, 1922, of internal malignant disease.

Of the 204 cases, 24 died in the hospital and 9 after discharge; 24 are unheard from. Of the remaining 147 cases, 26 of them, operated upon since January 1, 1921, are considered too recent for analysis. This leaves, then, 121 patients for analysis. From 45 of these I have received adequate reports from the local physician or competent answers from the patients themselves. I have personally examined 76 cases, in 73 of which final metabolic determinations were made. As many of the operations were done a long time ago, and in a few only ligations or hemithyroidectomy, the element of time and natural cure of the disease must be considered. In analyzing the end-results of 45 cases, which have not been personally examined by me and where no metabolic determination has been made, the word cure means that they have been freed from the symptoms of Graves' disease with the exception of exophthalmos.

UNIMPROVED

1. Woman of 51; double ligation, 1914; further operation refused; for years has been receiving organotherapy. Her condition is reported as not improved.

IMPROVED BUT NOT CURED

2. Woman of 33; in 1914, under local anæsthesia, right hemithyroidectomy; much improved but not cured.

3. Boy of 22; double ligation in May, 1919; X-ray treatment; metabolism, November, 1919, was +40; X-ray continued until April, 1920. Nine X-ray treatments after the operation. In July, 1920, improvement definite but not cured. Operation was indicated instead of a continuance of X-ray treatment.

4. Woman of 47; left hemithyroidectomy, April, 1911, with improvement. Patient lost sight of until 1919, when she reported with hypertrophy of the right lobe and a return of the symptoms. Operation was refused. X-ray treatment was advised She reported again in 1922. Right lobe had again increased in size during the past 4 months; menopause a year ago. X-ray again advised owing to a very high blood-pressure, myocardial insufficiency and glycosuria. Under X-ray treatment the lobe has diminished one-half and the symptoms are less marked, but the patient is not cured.

CURED WITH MENTAL SYMPTOMS

5. A man of 23; right hemithroidectomy in 1919 In January, 1922, physically cured, but in Danvers State Sanatorium with delusions of persecution.

6. A woman of 43; duration 11 years with intermittent attacks; separate ligations in September, 1919; subtotal thyroidectomy in October; much improved but mental derangement increasing. In November, 1921, cured of Graves' disease, but committed to Danvers State Sanatorium with a diagnosis of climacteric insanity.

7. A woman of 55; hemithyroidectomy in March, 1913; March, 1916, much improved physically but subject to attacks of mental depression. In 1922 physically perfectly well, but attacks still occur.

8. A woman of 46; severe Graves' disease; subtotal thyroidectomy in 1918; is now cured of all her symptoms and can lead a normal social life, but at times has homicidal delusions, which, however, have led to no act of violence.

CURED WITH CARDIAC SYMPTOMS

9. A man of 40; typical symptoms of Graves' disease; partial thyroidectomy under local anæsthesia by another surgeon on August 18, 1917; hypertrophy of the left lobe; partial left lobectomy by the same surgeon, November 28, 1917; no improvement for 4 months; remainder of the right lobe hypertrophied. Operation by me, January 14, 1918: right upper one-half of lobe removed. In October, 1921, cured of Graves' disease, but his heart is seriously impaired.

10. A woman of 45; typical symptoms; in addition, myocardial disease, systolic murmur, albuminuria and approaching menopause. Subtotal thyroidectomy under local anæsthesia in 1917; in fall of 1921 her doctor says that the Graves' symptoms have disappeared, but the patient is a cardionephritic with a very high blood-pressure and subject to uræmic attacks. Pulse 80.

11. A Jewess of 18 with multiple congenital valvular disease; ligations under local anæsthesia 1913 and 1914 with improvement. Right hemithyroidectomy in 1920. Cured of Graves' disease. In January, 1921, survived a severe attack of pneumonia and streptococcus septicæmia. This girl, though at first a very bad risk, was operated upon because I did not believe her congenital heart could bear the toxæmia of Graves' disease. I am convinced that had she not been operated upon she would certainly have died from pneumonia in 1921.

12. A woman of 50, with myocardial disease and mitral insufficiency; œdema of both legs. Right hemithyroidectomy with isthmus and ligation of vessels on the left in 1911. Show and gradual improvement in spite of heart. In 1921 she is a cure, but has occasional attacks of cardial decompensation.

CURES

These cases which follow are cures after various operations.

13. Double ligation in 1916, woman of 33; in 1922 she is cured.

14. Double ligation in 1911 for severe Graves' disease, girl of 20; hemithyroidectomy by another surgeon in 1913; now perfectly well.

15. Double single ligations in 1914, woman of 30; right lobe and isthmus removed one month afterward. In 1922 she is cured.

16. Double ligation under local anæsthesia; man of 23, in November, 1912. Hemithyroidectomy in December, 1914; in 1921 a striking example of a complete cure.

17. Right hemithyroidectomy and multiple suture of the left lobe to cause anæmic necrosis, performed on a woman of 28, in December, 1911. She became temporarily insane but recovered in a few weeks. Now married and perfectly well, October, 1921.

18. A woman of 28; several X-ray treatments without improvement; hemithroidectomy in 1908; married in 1910; two children; puerperal mania after second childbirth, but recovered and is now perfectly well.

19. A woman of 29; very severe Graves' disease; right hemithyroidectomy in 1908; has since married; in 1922 has three children and is well.

20. Hemithyroidectomy with removal of isthmus, woman of 35, in 1915; complete cure.

21. Right lobectomy in 1911, woman of 27; in 1922 she writes she is working in a restaurant and is perfectly well.

22. Hemithyroidectomy in 1911 for severe Graves' disease, woman of 50; in 1922 a cure.

23. Hemithyroidectomy in 1917, woman of 25; in 1922 she reported that she had gained 40 pounds and was cured.

24. Removal of right lobe and isthmus in 1911, woman of 26. In June, 1915, was very much better but not cured. In October, 1921, she was in perfect health.

25. Removal of left lobe and isthmus in 1917, woman of 28, in 1921 she writes she never felt better.

26. Right hemithyroidectomy in 1917 in a man of 30; metabolism before operation, +60. In May, 1922, metabolism +3. In 1922 patient is perfectly well.

27. Left hemithyroidectomy and removal of isthmus in 1918, woman of 24; in 1922 a complete cure.

28. Right hemithyroidectomy under local anæsthesia in June, 1920, woman of 38; in August, 1921, she is cured.

29. Left hemithyroidectomy, woman of 26, in January, 1919. In 1922 a cure.

30. Left hemithyroidectomy, woman of 36, in May, 1912. In 1921 a cure.

31. Left hemithyroidectomy in 1920, negress of 40 with a toxic adenoma. Operation under local anæsthesia. In October, 1921, is cured.

32. Separate double ligations in December, 1913, woman of 26. In November, 1915, subtotal thyroidectomy. In March, 1922, completely cured.

33. Subtotal thyroidectomy under local anæsthesia in 1916, woman of 36; in the fall of 1921 perfectly well.

34. Subtotal thyroidectomy, woman of 44 on March 18, 1918. Persistent bilateral abductor paralysis required a trachectomy 6 months afterward. In 1922 cured of all symptoms of Graves' disease but still wears a tube.

35. Subtotal thyroidectomy, under gas and oxygen, in 1917, woman of 45. Patient married shortly after leaving the hospital; in 1922 she has three children and feels perfectly well.

36. Woman of 36; right hemithyroidectomy early in 1917, and in June of the same year two-thirds of the left lobe was removed. In April, 1919, she was working daily and feeling fit with a metabolism of +10. In 1922 she was married and is well

37. Subtotal thyroidectomy, woman of 21, July, 1919. In 1921 she was perfectly well. She is now pregnant with no symptoms of Graves' disease and is well. Successful pregnancy in March, 1922.

38. Subtotal thyroidectomy in 1920, woman of 29; in September, 1921, she is perfectly well.

39. Subtotal thyroidectomy, woman of 40, in November, 1915. No note of her progress until November, 1921, when she was in perfect health

40. Woman of 48; right hemithyroidectomy with removal of isthmus, under local anæsthesia, in 1916 In January, 1917, partial resection of the left lobe Has gained by 1922, 39 pounds and is a complete cure.

41. Subtotal thyroidectomy in 1917, woman of 31; in August, 1921, is cured except for exophthalmos, which is still marked.

42. Subtotal thyroidectomy, under local anæsthesia, in 1911, woman of 29; in October, 1921, completely cured.

43. Subtotal thyroidectomy in February, 1918, woman of 47, followed by a bilateral abductor paralysis, probably hysterical. In 1922, the larynx was examined and found to be normal. She is in perfect health.

44. Subtotal thyroidectomy in 1919, woman of 30; cured. Successful confinement in October, 1921. In February, 1922, is perfectly well.

45. Subtotal thyroidectomy, woman of 34, in February, 1920; in November, 1921, completely cured.

In reporting the 45 cases not personally examined by me, I used the word *cure* as meaning that they were freed from their

previous Graves' symptoms and able to do their ordinary work. I must confess, however, that such a cure is often a relative term, for with all the complications which attend this complex disease, physical, neurological and mental, acute or chronic, in the young or in the old, it must be that many patients come for treatment with organs already so damaged that a *restitutio ad integrum* could never take place. For this reason I have taken little interest in the percentage of figures of so-called cures. When is a patient with Graves' disease really cured? I believe we must consider first the disease and then the patient. I suggest that the best index of cure of this disease is a *permanent reduction of the basal metabolism to normal*. This is all that the X-ray or surgery can accomplish, and more quickly than rest, medicine, and the natural burning out of the disease with its permanent degenerations. If this conception of a cure be true we see the limitations of surgical treatment. Operations will then be divided into curative and palliative as in other diseases. A real *cure* of the *patient* may be expected only when at the time of treatment no damage to the tissues has resulted which may not be repaired by time. No matter how radical the operation, even if the metabolism rate becomes normal, it must be a palliative operation, so far as the patients cure is concerned, if permanent changes have taken place, from which recovery is impossible. This fact, I think, is too frequently forgotten in our endeavor to claim for surgery complete cures in Graves' disease, for it follows that a cure of the patient depends quite as much on the stage of the disease and attendant complications as upon a wise choice of graded operations. For example, exophthalmos may exist long after the patient is well; valvular disease, cardionephritic conditions and chronic bronchitis will outlast treatment; but instead of considering these as contra-indications to operation I consider them as indications for palliative operation, to relieve the patient as soon as possible from the added toxæmia of Graves' disease. I have been surprised at the improvement in several instances of chronic valvular disease where this additional burden has been lifted.

Of 76 cases personally examined, there are 4 cases on whom no final metabolism tests were obtained. One was a case of double ligation in October, 1918, followed by six X-ray treatments. She was confined in April, 1922, and is now living and well. Another is a woman who had a double ligation and hemithyroidectomy in February, 1915. She is now well with a pulse of 80 and working regularly every day. Another is a woman operated upon in February, 1914, double separate ligations and in November, 1915, subtotal thyroidectomy. She reported in 1921 cured of Graves' disease and in every way clinically a cure. Another, a woman operated upon in May, 1915, subtotal thyroidectomy, reported in 1922 perfectly well.

While the following analysis of results with regard to a normal basal metabolism shows a surprising number of cures after ligation and hemithyroidectomy, with or without X-rays, the most rapid and permanent results, as would be expected, have followed ultimate subtotal thyroidectomy.

DOUBLE LIGATION

Of 13 ligations, in a few of which the X-ray was also used, we have 11 recent metabolisms. Nine of them were within normal limits; by that I mean that their metabolism rate was plus or minus 5. One of these patients, who was treated by separate double ligations in May and October, 1920, with six exposures to the X-ray, has exactly doubled his preoperative weight to 164 pounds, and is perfectly well. Another case, a young girl, in October, 1919, with a metabolism of +70, had a separate double ligation in March, 1920, and subsequently nine X-ray treatments. She showed a remarkable disappearance of a very large goiter, and although now 6 months pregnant, her metabolism is only +13. In contrast to this is a woman, operated upon also in 1920, a double ligation, who has had eight X-ray treatments and is uncured. She was 5 months pregnant in November, 1921, with a metabolism of +51 and pulse 108 to 128. She refused further operation. In December, 1921, patient gave birth to a dead baby. She has since gained 6 pounds and the pulse is 84.

HEMITHYROIDECTOMY

Of 50 hemithyroidectomies we have final metabolic determinations in 35. Hemithyroidectomies in this series have shown some surprising end-results with approximately normal metabolic rates. In this, I believe, time is a factor. On the other hand, there are striking examples in which with hypertrophy of the remaining lobe, there have been severe recurrences of symptoms. One man in particular I have in mind:

In 1908 his normal weight was 198. After his symptoms developed he lost 84 pounds. After a hemithyroidectomy, on August 24, 1919, he gained to 182 pounds with a pulse of 72 on May 10, 1913. Owing to overwork there was a recurrence of symptoms with some hypertrophy of the other lobe, and in December, 1916, his weight fell to 120. Following a year's rest he recovered and his weight rose to normal again. For several months he had been running down hill with noticeable enlargement again of the left lobe. Influenza in January, 1920, increased these symptoms and he lost 44 pounds, with tachycardia and a metabolism of +56. On March 18, 1920, under local anæsthesia, four-fifths of the left lobe was removed. On April 6, 1920, his metabolism was +6 and his pulse 68. In six months he was perfectly well, again weighing 200 pounds. In August, 1922, he was maintaining this weight and is still well.

Another, a man of 55, had a double ligation on May 6, 1914, and in June of the same year a right hemithyroidectomy. He was apparently well until he had influenza in 1918, which was followed by hypertrophy of the other lobe and a return of the old symptoms, with auricular fibrillation. In spite of X-ray treatment for over a year his metabolism in January, 1922, was +37 and he was not cured.

Cases such as these and many others show a definite connection between infections and exacerbations of the Graves' symptoms, in the same way that the toxic thyroids after operation are found to have a predisposition to pulmonary complications when compared with the non-toxic goiters.

A man of 33 had a right hemithyroidectomy with basting of the left lobe, in April, 1915. He felt at his best 1 year after the operation. Since then he has had a gradual, though slight, return of the old symptoms. He feels that operation helped but did no cure him, although he can do a regular day's work. He has gained 13 pounds and his pulse has dropped from 100 to 90. The metabolism on November 8, 1921, is just what it was before the operation on April 10, 1915, +30 per cent. In other words, in spite of operation six years ago, he is still uncured.

A woman operated upon in March, 1917, has had hypertrophy of the left lobe. Her metabolism is +22 per cent, but she is working regularly. She has regained her normal weight and her pulse has dropped from 105 to 92.

With these exceptions the operations of hemithyroidectomy has resulted in an unexpected number of cures, judged by the standard of metabolism.

1 case in 1909 is +3 per cent;
1 case in 1911 is +11 per cent;
4 cases operated upon in 1912 average +3 per cent;
5 cases in 1913 average +5 per cent;
5 cases in 1916 average +5 per cent;
5 cases in 1917 average +½ per cent;
6 cases in 1919 average +5 per cent;
5 cases in 1920 average +5 per cent.

SUBTOTAL THYROIDECTOMY

Of the subtotal thyroidectomies we obtained 28 metabolic determinations in 50 cases.

1 case in 1909 is 0 per cent.
5 cases in 1911 operated upon average +3 per cent;
3 cases in 1914 average +1 per cent;
3 cases in 1915 average 0 per cent;
2 cases in 1916 average +5 per cent;
6 cases in 1919 average +1 per cent;
1 case was pregnant with a metabolism of +10 per cent;
7 cases in 1920 average +6 per cent.

There have been 3 cases in which the metabolism was subnormal. In all of them since the operation there has been a marked increase in weight. In none of them was there definite evidence of myxœdema:

Case 1. A man of 40; before operation, weight 92 pounds; double ligation in July and August, 1913; no X-ray treatments. In 1917 and 1920 he had two relapses. In March, 1922, his metabolism was −13 per cent and his weight 171 pounds.

Case 2. A woman of 41; normal weight 158 pounds. In June, 1913, she weighed 136 pounds; on August 20, 1913, right hemithyroidectomy and ligation of the left superior thyroid artery. On November 8, 1914, two-thirds of the left lobe was removed. On October 15, 1921, she weighed 211 pounds, pulse 54 and metabolism −16 per cent. Under thyroid her weight dropped to 201 pounds, the pulse rose to 70 and the metabolism to −5 per cent.

Case 3. A woman of 45, whose normal weight was 160 pounds, weighed 125 pounds before a subtotal thyroidectomy on April 29, 1920. Her metabolism previous to operation was reported as +30 per cent, but all her symptoms were more definite than the metabolism would suggest. On October 15, 1921, she had regained her normal weight and 5 pounds more. The pulse was 80 and the metabolism −17 per cent. In January, 1922-she weighed 187 pounds. Under thyroid tablets she lost 3 pounds, but says she feels no differently.

There is then a possible danger of subnormal metabolism and myxœdema after a surgical procedure as well as after treatment with the X-rays, although a definite diagnosis of myxœdema, as before stated, could not be made in these cases.

I wish now to speak of an unfortunately large number of injuries to the recurrent nerves in this series, excluding malignant cases, amounting to 10 per cent. Most of these, though not all of them, occurred in the earlier operations, when I frequently performed total lobectomy and often delivered the lobe with fingers or made traction upon it with double hooks. A very small number recovered from the paralysis, though, as I have said at the beginning of the paper, the voice often becomes almost or quite normal in a few months. In particular I wish to mention 5 most distressing cases of bilateral abductor paralysis. Two followed operations by other surgeons and 3 are my own cases. One entirely recovered at the end of 6 months and was largely hysterical. A second followed operation in a girl of 16 for non-toxic goiter, and was apparently a factor in a rapidly fatal influenza-pneumonia 4 years after operation. In a third, tracheotomy was necessary, and although this operation was done 4 years ago, she still wears a tube. As the voice in these cases, although high-pitched, is not otherwise abnormal and the patients suffer only from dyspnœa at night or after physical exertion, the condition is probably more common than is recognized.

A careful laryngological examination is imperative. Until recently the laryngologist has hesitated to operate upon them locally. It is to be hoped that Chevalier Jackson's recently advocated ventriculocordectomy will cure this dangerous condition.

CONCLUSIONS

1. I believe that the X-rays, through the action on the thyroid and possibly on the thymus, will diminish the risk of operation and will permanently cure certain cases of Graves' disease. On the other hand I have seen cases in which X-ray treatment, though persisted in for as long as 2 years, has had practically no effect. Surgery promptly cured.

2. If 6 months' treatment with X-rays is not efficient, operation is indicated.

3. The best index of a cure of Graves' disease is a *permanent reduction of the basal metabolism to normal.*

4. Whether the patient will be cured or not depends on the stage of the disease at which treatment is instituted and the degree of irreparable damage which has already resulted.

5. Though ligation and hemithyroidectomy may cure many patients, ultimate subtotal thyroidectomy most quickly and permanently reduces the metabolism to normal.

6. The psychoses of this most interesting disease, which seems frequently to occur in neuræsthenic individuals, requires long after-treatment.

Discussion

Arthur D. Bevan, M.D., Chicago: I wish to emphasize the great value of local anæsthesia in toxic goiter cases. In my own work in a large series of very toxic cases I have practically discarded any form of general anæsthesia, whether ether, nitrous oxide or oxygen, and I am quite sure that this has made a very great change in my results.

Then, too, I am much impressed with the importance of operating on the bad cases by installments, not doing too radical an operation at first. Preliminary ligations are of value before considering the advisability of the actual removal of the gland; my own experience has been that the ligation of one thyroid is not of very great service; ligation of two is of very definite service and ligation of three has usually a very marked effect upon the reduction of the toxic symptoms. I would like to emphasize this very strongly, because I have seen many cases die under a general anæsthetic under ether and gas and oxygen, and I am much impressed with the great importance of operation under local anæsthesia in the bad cases.

One word in regard to basal metabolism: I find my own attitude toward this subject about this. We have had basal metabolisms taken by one of our colleagues, who is very well trained in this department, for some time, but I find that I am constantly

determining the question for or against operation by my own impressions of the clinical picture and that I am not guided by the metabolic rate. It is a good deal the same as a leucocyte count in an appendix operation or some other abdominal lesions where the clinical picture definitely determines the question of an operation whether the leucocyte count is in favor or against

MARTIN B. TINKER, M.D., ITHACA, NEW YORK: I was much interested in hearing Dr. Porter's report, and also to learn that they have really cured malignancy of the thyroid. In my paper I called attention to the fact that certain Fellows of this Association take a very pessimistic view with regard to thyroid malignancy, particularly where the disease is so far advanced that a probable diagnosis can be made before operation. There are at least 4 cases reported by members of this Association in which cure has lasted over 4 years after removal of such malignancy.

Dr. Porter spoke of some of the more desperate cases in which he had been obliged to remove a portion of the jugular in connection with the removal of the thyroid. We have had at least two such cases, and in certain cases where the infiltration of the tissues of the neck has gone on so far that it would be impossible entirely to remove all of the disease without killing a patient, we have used radium and have two patients living over 5 years. Both patients were treated by Dr. Howard A. Kelly, of Baltimore.

As regards the use of the roentgen-ray in these cases, it seems to me that we are still in the experimental stage and it is doubtful what the actual effect is in such cases. I would like to put on record at least 3 instances in which patients with moderate toxæmia or no toxæmia have been thrown into a state of extreme toxæmia, apparently the result of the use of the roentgen-ray, by men who are supposed to be very good in their line. They were not all by roentgen-ray men of my own locality. My own observation is that those patients treated by by roentgen-ray are among the patients who develop myxœdema afterward. Some of you will recall that Dr. Osler, in his *Practice of Medicine*, states that myxœdema following thyroid operation is extremely rare in this country, only 2 cases having come under his observation, and later 1 case was apparently cured. This is a very low percentage of myxœdema, but with the use of the roentgen-ray I feel that there is a very great increase. I have observed a number of cases in which myxœdema has resulted in these cases.

As to the reliability of the metabolic rate as a criterion of hyperthyroidism, is it not true that patients with a persistently high metabolic rate but in whom other clinical symptoms did not check up proved to be suitable for operation?

I believe that the many-stage operation in toxic goiter cases has, in the experience of a large number of men, made the difference between life and death.

WALLACE I. TERRY, M.D., SAN FRANCISCO: I wish to sound a warning against the use of roentgen-rays in adenomata of the thyroid, particularly where the adenomata constitute the greater part of the goiter. I have seen a number of cases of myxœdema follow the use of roentgen-ray for adenomata—the active part of the thyroid itself is destroyed.

A. MACLAREN, M.D., ST. PAUL, MINNESOTA: It seems to me that the question of local anæsthesia is a very important one in operations for goiter. I believe there is less danger of bronchopneumonia, and we do away almost entirely with the danger of tying the recurrent laryngeal nerve. I pinched a recurrent laryngeal nerve a year ago. I immediately recognized the fact from the harsh, rasping voice of the patient. I immediately took off the clamp and I had an opportunity to examine her larynx immediately afterward and again a week ago. She had no paralysis of the vocal cord.

C. A. PORTER, M.D., BOSTON (CLOSING): I merely wish to emphasize three points. I have operated upon many patients under local anæsthesia, which I always use, when there is any question of pressure on the trachea.

In 2 cases there was a marked increase in weight and the question of myxœdema arose. In only 1 case were there clinical symptoms. This patient normally weighed 150 pounds, which dropped to 136 pounds in 1 month. In August, 1913, I did a right hemithyroidectomy and ligated the superior thyroid artery. She improved following the operation, but still had some symptoms. In the latter part of 1914 I removed the anterior two-thirds of the left lobe. She was lost sight of until October, 1921, but she said she had steadily improved in the meantime, but complained of sleepiness and a growing discomfort, due to overweight, which was 211 pounds. Her metabolism, done at Dr. Means's laboratory, at the Massachusetts General Hospital, was —16 per cent. She was at once put on thyroid tablets, grains ½ which was continued for 4 months. In March, 1922, her metabolism was —5 per cent and her weight had dropped to 200 pounds. She was generally much improved and the thyroid was discontinued. She is now 46 years old.

There were 2 cases of myxœdema following roentgen-ray treatment, both of which yielded to thyroid tablets. This was discontinued after 6 months without a return of the symptoms.

In regard to metabolism, I consider it only a very important factor in diagnosis, but I wish to emphasize its very great importance as an indication of cure, as far as roentgen-rays and operation can cure overactivity of the gland. In other words, if the metabolism has been reduced to normal we can call the patient cured of Graves' disease in so far as a cure is possible. Exophthalmos may persist and there may be permanent visceral lesions or myocarditis, but these are the aftermath of Graves' disease, not the disease itself.

A METHOD FOR THE LOCALIZATION OF BRAIN TUMORS IN COMATOSE PATIENTS

The Determination of Communication Between the Cerebral Ventricles and the Estimation of their Position and Size without the Injection of Air (Ventricular Estimation)

By WALTER E. DANDY, M.D., Baltimore
From the Department of Surgery of the Johns Hopkins Hospital and University

If the character and location of all brain tumors were known or easy of determination, the treatment would be greatly simplified. If it could be demonstrated that the character or position of the tumor was such as to prevent its removal, palliative treatment would at once be instituted as the utmost resource at our command. But if both the character and position of the tumor were known to be such as to make its removal probable or even a possibility, every effort would be directed toward its extirpation, this being the only hope of a cure.

Unfortunately, however, not all of this information is as yet attainable even after all examinations have been made. In only exceptional cases, as for instance tumors of the brain-stem and of the left temporal lobe, can we know that its extirpation either is not possible or is not justifiable. Although there are often indications that tumors either do or do not lend themselves to extirpation, the evidence on this point is most unreliable and may be just as misleading one way as the other. With few exceptions, the character of the tumor is not ascertainable until the growth is actually seen and examined at operation. Because of the progressive, necessarily destructive, and fatal course of these lesions unless completely removed by operation, the patient's only hope lies in the assumption that *all* tumors are curable until proven otherwise.

Fortunately, we are now able to determine the *location* of practically all brain tumors, so that by their inspection at operation the character of the growth can at once be known and either the palliative or curative treatment instituted at that time. With very few exceptions, the kind of tumor can be as accurately told by its gross appearance at operation as by a microscopical examination. Roughly estimated, not many more than 50 per cent of all brain tumors are localizable by neurological and roentgenological examinations, and it is for the localization of the other half that cerebral pneumography is of the greatest value.

We believe very firmly that no surgical treatment should be attempted until the location of the tumor is as precisely known as possible; that *primary* palliative treatment should never be done until a tumor is known not to be removable. We feel that the only treatment for brain tumors is to treat the *cause* directly; and that the tumor should be *completely* extirpated, and promptly, when possible.

There are times when this procedure may seem impractical or very difficult. Particularly is this true in those patients who are seen for the first time in the last stages of intracranial pressure, i.e., when in coma or when coma is impending. But under such circumstances, an accurate localization is far more important than when the patient's general condition is good. The correct treatment will often save the patient's life, while a misdirected operation will merely hasten the end. Cerebral pneumography[1] has been invaluable in these cases, for the patient may be so deeply unconscious that the results of the neurological examination may be negligible and the history obtained from others either inaccurate or misleading. However, in these cases the use of cerebral pneumography may, in itself, be very serious on account of the aggravations of pressure symptoms due to the effects of the air (a factor now largely under control), but still more so because of the time lost in making the examinations, and may reduce, more than it helps, the chances of a cure.

[1] I regret that press of time has so far precluded the publication in detail of the large series of brain tumors in which the use of cerebral pneumography has been the means of localizing the growth. It is hoped that this may appear in the ensuing year

If, under these circumstances, it were possible to make a localization of the tumor without injecting air into the ventricles, the patient's chances would be considerably increased. It is the purpose of this paper to propose a quick method by which a localization can usually be made *in such emergencies*. It is not without its possibilities of error but, taking everything into consideration, it seems to offer the most to the patients in their very desperate condition. It is recommended with hesitation and only as an emergency procedure. It is possible that the procedure may be useful in a few cases where the information obtained is sufficient to eliminate a definite region of the brain, when it seems certain that the tumor can be in one of only two possible situations. At all other times when there is doubt as to the tumor's location, presuming, of course, that the patient's condition is favorable, the other precise method of cerebral pneumography should be used.

The method proposed is to *estimate the size, position, and intercommunication of the ventricles by aspiration of the fluid in the lateral ventricles (and at times from the cisterna magna)*. We have learned from necropsy material but particularly from ventriculography that practically all brain tumors which cause intracranial pressure alter the size, shape, or position of part or all of the cerebral ventricular system; and the situation of brain tumors is, therefore, determined by the deviations in the size, shape, and position of the ventricles.

The position of the lateral ventricles can be determined by ventricular punctures; their size by measuring the fluid in the ventricles; and their communication with each other by injecting a dye into one ventricle and testing for the color elsewhere in the ventricular system. This information, while it leaves much still to be desired, is usually at least sufficient to tell whether either cerebral hemisphere or the cerebellum is the likely seat of the tumor.

Since the introduction of cerebral pneumography, it has been our custom to make a small perforator opening in the occipital region of *both* sides of the skull. Frequently one ventricle is collapsed or displaced by a tumor and cannot be reached by ventricular puncture, but it will be exceptional for both ventricles to be inaccessible. Usually the puncture of only one ventricle is necessary for cerebral pneumography, but since we cannot foretell which ventricle can or cannot be reached, and since at times both ventricles must be tapped, it is better to have both ventricles under control. The two openings can be made as easily and safely as one. The occipital region is chosen because the largest part of the lateral ventricle, the vestibule, is most accessible from this point. Moreover, the vestibule of the ventricle is, on the whole, less easily collapsed and dislocated than other parts of the ventricle. At times we have used bilateral punctures of the anterior horns of the ventricles but here the ventricles are smaller and consequently harder to enter. Moreover, dislocation and collapse of both anterior horns is more likely because they are closer together and, therefore, more equally affected by any pressure directed from the side. The vestibules and posterior horns are farther apart and are less equally occluded by the same pressure. Another anatomical factor which carries weight is that the anterior puncture must be nearer the midline and consequently through a field of larger veins which are nearing the longitudinal sinus. These may easily be punctured, whereas the posterior puncture is through a less vascular area. The lateral puncture into the descending horn has been used very sparingly and practically never bilaterally. At times a patient has previously had a decompression performed and an attempt may be made to enter the ventricle under these circumstances. A lateral puncture of the left side would hardly be considered because of the important speech areas which the needle must traverse. For ventricular estimations we have used the same posterior approach to the ventricles. *Punctures of both ventricles are then always necessary* (Fig. 1).

THE POSITION OF A LATERAL VENTRICLE

By experience it will be known that a normal lateral ventricle should always be entered from a given point when the ventricular needle is inserted in the proper direction

and to a given depth. With practice one acquires a certain degree of confidence in this determination. If the ventricle is enlarged from hydrocephalus, it will be even more easily reached and usually at less depth. When neither ventricle can be *reached* by properly directed punctures, it is strong evidence that hydrocephalus is not present, and this will at once signify that the tumor cannot be in the cerebellum, third ventricle, or brain-stem. When the ventricle is entered, it is usually not possible to say more than that the ventricle is not dislocated. Whether the ventricle is of normal size or enlarged, can be determined only by *measuring* the fluid which it contains. If only a few drops of fluid escape from the needle, the ventricle may be considered smaller than normal, but attempts to aspirate will always make this deduction safer. Occasionally, neither ventricle can be reached in the normal position, but one or both may be entered at a distance to the right or to the left. Such a displacement, when definite and particularly when known to be the same on both sides, can be explained only by the effects of a tumor; and the tumor must be on the side *from* which the dislocation has occurred. If the lateral deviation of the ventricles has been shown by a *posterior* ventricular puncture, it is presumptive evidence of a tumor in the *posterior* half of the cerebral hemisphere, for tumors in the anterior half of the hemisphere will hardly cause such a pronounced dislocation of the vestibules of the lateral ventricles. Doubtless more and greater deviation of the anterior horns would be demonstrable by puncture of the anterior horns, but the evidence of dislocation of the ventricles from a puncture is far less important and less reliable than the computation of the size of the ventricles. In one of our cases, however, the sole information of the tumor's position was learned from the dislocation of the ventricles (Case 4). Both lateral ventricles were so small that no fluid could be aspirated but each ventricle was reached far to the right of its normal position.

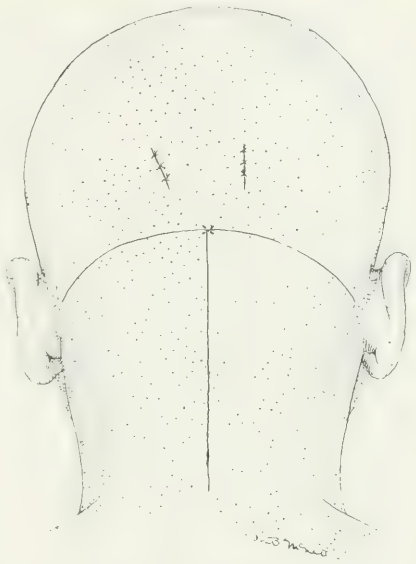

Fig. 1. To show the position for bilateral ventricular punctures. A cerebellar incision is outlined for orientation. For the puncture, either a slight oblique or ventrical incision can be made.

SIZE OF THE LATERAL VENTRICLES

From a large series of ventriculograms it has been found that the size of the normal lateral ventricle is most variable. Indeed, to differentiate between a large normal, and a small hydrocephalic, ventricle, often requires close study. But apparently the lateral ventricles in the same patient are of equal size unless there is some lesion to cause inequality.

We have also learned that the lateral ventricle is always smaller on the side of a cerebral tumor (excluding a resultant localized hydrocephalus) than on the opposite side and usually the difference is very striking. Indeed, the ventricle on the side of a tumor is usually so small that it cannot be reached by a ventricular puncture or, if reached, only a few drops of fluid will escape. Occasionally, as in one of the cases reported here, the size of both ventricles may be tremendously reduced, but usually there is a considerable difference in their size. For this reason, if we find one lateral ventricle from which 25 cubic centimeters of fluid can easily be aspirated, and

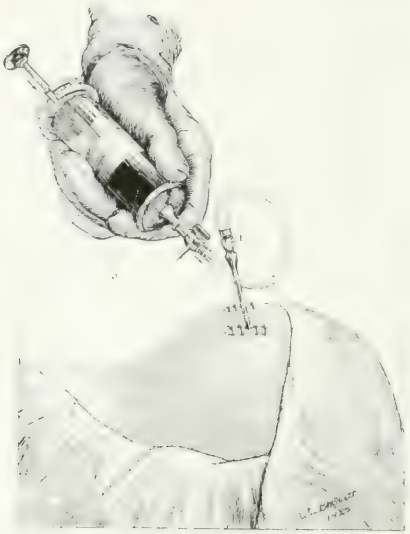

Fig. 2. To show method of ventricular puncture and aspiration of the ventricle and injection of indigocarmin (a).

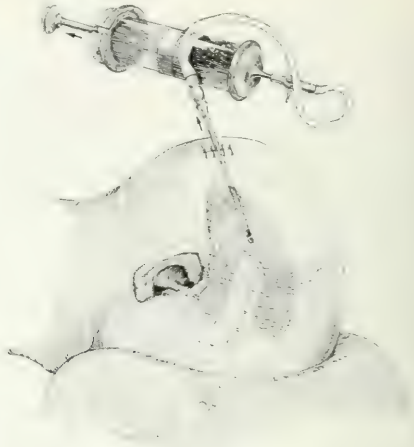

Fig. 3. Diagram, with lateral ventricles outlined, indicating the approximate course of the ventricular needle.

only 1 or 2 cubic centimeters can be obtained from the other ventricle, we may feel fairly confident (after excluding a block in the ventricle) that the tumor is on the side of the small ventricle. Again, if we can easily aspirate 25 cubic centimeters of fluid from a lateral ventricle, it is fairly safe (there are exceptions) to assume that a tumor does not exist in that hemisphere, for such a tumor would by this time have consumed that space in seeking room for expansion (we are now considering only patients in coma or with coma impending). And if both lateral ventricles are of equal size, it would be fairly safe to assume the presence of hydrocephalus and, therefore, that the tumor is in the cerebellum, brain-stem, or third ventricle. For practical purposes, we have come to look upon the aspiration of 25 cubic centimeters of fluid as a standard quantity upon which to draw conclusions. The aspiration of more fluid would usually require the injection of air to prevent too much negative pressure. In this connection, it should be emphasized that any conclusions drawn from the amount of fluid obtained by ventricular puncture alone, i.e., without aspirating fluid, are too capricious to be in any way reliable. The amount of fluid which spurts from a ventricular needle, except when the ventricle is very small, only indicates in a rough way the degree of intracranial pressure. From a ventricle of normal size or even smaller than normal, there will be a considerable spurt of fluid; a hydrocephalic ventricle may not give more. It is the reserve in the ventricle after the pressure relief which is important. A ventricle of normal size would exhaust its fluid in only partially relieving the intracranial pressure, and there would be no fluid in reserve for aspiration, but, from a hydrocephalic ventricle, additional fluid will still easily be obtained after the pressure has been relieved.

A small ventricle in one cerebral hemisphere will eliminate a tumor of the cerebellum, brain-stem, or third ventricle, but will not eliminate a unilateral hydrocephalus or focal hydrocephalus on the other side; and conversely, the demonstration of a hydrocephalus on one side does not prove a tumor to be in the cerebellum, brain-stem, or third ventricle.

Fig. 4. *A*

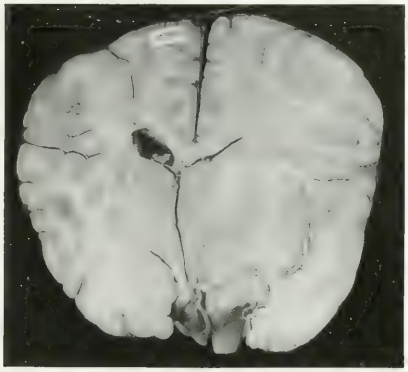

Fig. 4. *B*

Fig. 4. *A* (at left), Shows the tips of the frontal lobes. The right hemisphere is dislocated toward the left by an abscess in this lobe. The increased bulk in this section is largely due to œdema surrounding the abscess, which is small. It will be seen that the anterior horn of the ventricle on the side of the abscess is absent and that the ventricle on the opposite side at this level is reduced to a slit. Doubtless the pressure of the bulging right hemisphere on the left pyramidal tract was the cause of the false localizing sign—right Jacksonian epilepsy. *B*, Section slightly posterior to *A*. The ventricle on the side of the abscess is still obliterated while the ventricle on the opposite side is approximately of normal size. The dislocation of the third ventricle and of the lateral ventricles, can also be seen.

It is never safe to draw conclusions from one lateral ventricle alone; the status of both ventricles must always be determined (Fig. 1); inferences from both still leave too many possibilities of error. It is hardly necessary to add that in drawing conclusions of such character, one must be very confident of his ability to reach a normally placed ventricle; also that some extraneous factor such as a plugged needle is not causing erroneous deductions to be drawn.

COMMUNICATION BETWEEN THE VENTRICLES
THE INDIGOCARMIN TEST

An additional method of ventricular estimation is most useful in further reducing the chances of error in those cases in which the tumor has caused hydrocephalus. If 1 or 2 cubic centimeters (depending on the size of the ventricle) of indigocarmin[1] is injected into a lateral ventricle, aspiration of the contralateral ventricle will easily indicate whether or not the two lateral ventricles are in free communication (Figs. 2 and 3). If the dye does not pass from one ventricle to the other, there must be a tumor in the anterior or the middle and not the posterior cranial fossa. If both ventricles are dilated and the dye passes freely to the opposite side, the tumor will be in the posterior cranial fossa. Exceptions to the latter assumption are some pineal tumors and also those long-standing cases of hydrocephalus where an artificial communication between the lateral ventricles has resulted from pressure atrophy of the septum pellucidum; these atrophic openings have assumed this function of the foramina of Monro. This dye test is also useful in deciding whether the lateral ventricles communicate with the cisterna magna or the spinal sub-

[1]We formerly used phenolsulphonephthalein for this test but if quantitative determinations are not necessary, indigocarmin will do just as well. Apparently it is not irritating, whereas phenolsulphonephthalein, even when carefully prepared, may be very decidedly so.

For some time we have injected indigocarmin into a lateral ventricle as a routine procedure in all cases where a cerebellar operation is performed for tumor. It gives a striking objective demonstration of the location of the tumor, for the dye will not appear until the obstruction has been reached and passed and, if by chance the hydrocephalus is not due to tumor, the pressure of the dye in the cisterna magna will be excellent proof.

arachnoid space. At times it may be uncertain whether the lateral ventricles are hydrocephalic or merely of large but yet normal size. Again, the ventricles may be hydrocephalic but it may not be clear whether a tumor or another condition is responsible, i.e., whether the hydrocephalus is due to an obstruction or to an increased production of fluid. If an obstruction (usually a tumor) is the cause of hydrocephalus, the dye will not appear in the cisterna magna or the lumbar subarachnoid space. If the hydrocephalus is due to an increased production of cerebrospinal fluid (cardio-vascular-renal; chronic inflammatory reaction, etc.), the dye will freely pass into the cisterna magna or the spinal subarachnoid space. This communication or obstruction can be determined by aspiration through a lumbar puncture or a cisternal puncture (Ayer's puncture) or by operative exposure of the cisterna magna. We are strongly prejudiced against lumbar punctures in all cases where intracranial tumor is suspected, because of frequent medullary injury; except where intracranial pressure is first relieved by ventricular puncture, it should never be done and even then we would be most hesitant when a patient is in coma. Ayer's puncture would be at least equally dangerous for the same reason and also because the cisterna magna will always be obliterated by tumors in the posterior fossa. In cases where there is doubt and a tumor of the posterior fossa seems a probability, it is much safer to expose the cisterna magna. If the tumor is present, the operative procedure is necessary and if not present, we have erred on the safer side and done no harm. Uncertainty of this kind must be rare, but one such example recently came to our attention and will later be considered in some detail (Case 5).

The possibilities of this method developed during an exploration of the left cerebral hemisphere in a patient in deep coma from intracranial pressure.

A few hours after his arrival at the hospital, patient suddenly became unconscious. Fairly satisfactory examinations were made by Drs. Boggs and Thomas. The presence of an intracranial tumor or abscess was known because of the headaches, torpor, vomiting, and bilateral choked disc. There were, however, no positive localizing neurological findings except Jacksonian convulsions beginning in the right hand, spreading over the *right* side and eventually becoming bilateral. This history seemed sufficient to indicate a left cerebral lesion and this side of the brain was explored. In view of a history of sudden pain in the frontal region (bilateral), high fever for 3 weeks, swelling and closure of the *left* eye, immediately preceding patient's present illness, it was thought likely by both Drs. Thomas and Boggs that the lesion might be an abscess rather than a tumor. It should also be noted that the left pupil was much larger than the right. There had never been any localization of the headaches. He had had many convulsions while at home but in none had any focal character been observed. It was during examination in the hospital that the Jacksonian attack was seen. There was no motor or sensory inequality and the reflexes on the two sides were equal; no Babinski or ankle clonus on either side. There was bilateral choked disc of 6 diopters. The X-ray examination was negative. There seemed little doubt that the lesion was on the left side. Before beginning the operation, characteristic Cheyne-Stokes respirations developed and his color was cyanotic. Feeling that, should a tumor be found, his condition would not warrant its removal, only a decompression was planned, but in such deep coma the ordinary sized decompression would have been of little value. It is our custom in such extreme coma quickly to turn down a small bone-flap on the suspected side of the tumor. The operation can be done as quickly as the usual subtemporal decompression, and it has two great advantages: (1) it allows us to obtain very valuable information of the character of the tumor, thereby giving additional possibilities of treatment, and (2) if the tumor is found to be inoperable, all or part of the bone-flap can be removed, giving a larger and more effective decompression. At times a cyst may be encountered and its simple evacuation will give far more effective relief than any form of decompression alone. Ofttimes the patient's condition is sufficiently good to permit complete extirpation of a favorable tumor even at this operation. At other times an enucleable tumor may be encountered but the patient's condition may be too poor to permit its removal at this time but at a subsequent stage. Partial or total removal of the bone-flap will serve as a decompression until a succeeding stage. Experience alone can decide whether a one-stage or two-stage operation should be done in such emergencies. The general condition of each patient must be the guide in each. Always the one-stage operation is preferable, other things being equal, but tumor extirpations are such tremendous undertakings that it is always better to err on the side of safety and, when the patient's condition is not the best, to reserve extirpation for a second stage.

According to the above plan of treatment, a small bone-flap was quickly reflected on the left. A very

tense dura was exposed and incised concentrically. No anæsthetic was given at any time during the operation. The brain was allowed to protrude slowly through the dural defect and a big cerebral herniation bulged through the dural defect. No abnormality of any part of the cerebral cortex could be seen or palpated. The configuration of the lateral ventricle could easily be mapped out throughout practically its entire extent, a finding which usually denotes a large ventricle. A ventricular needle was passed into the vestibule of the ventricle and 25 cubic centimeters of fluid was aspirated. It contained 21 cells, suggesting that the lesion was probably an abscess. After release of the fluid, the outline of the ventricle was sharply shown by the indentation of the sunken cortex. The bone-flap was removed and the galea and skin quickly closed. These findings were interpreted as follows: with a ventricle so large, a tumor could not exist in this hemisphere and particularly as the enlargement was of the entire ventricle and not of a portion only. But it seemed possible from this data alone, to tell even more than merely to exclude this hemisphere as the seat of the tumor. When this ventricle was emptied there still remained intracranial pressure, i.e., there was still a big hernia of the brain through the dural opening. If the tumor were in the cerebellum or the brain-stem, there would be a bilateral hydrocephalus and after a puncture with aspiration of the fluid in this ventricle, the pressure in both cerebral hemispheres would be equally released, at least sufficiently to allow the brain to sink below the level of the dura, thus making the intracranial pressure negative instead of positive. We were, therefore, forced to conclude that a tumor mass must exist in the other (right) cerebral hemisphere; that the hydrocephalus (if such it was) must be confined to the side of operation and therefore be unilateral. The unilateral hydrocephalus must be due to closure of the third ventricle and the foramen of Monro on the operated side.

No benefit resulted from the decompression and the patient died on the following day. At necropsy an abscess of the *right* frontal lobe was found (Figs. 4a and 4b). We had operated on the *left* side because of a Jacksonian convulsion beginning in the right hand! Had his condition warranted air injection, the location of the abscess could have been easily determined. The misplaced confidence in the Jacksonian attack need not concern us here. We are merely warned that apparently positive signs are not always reliable. Had the operation been performed on the side of the lesion, allowing drainage of the abscess, a better result might conceivably have followed, even in his extreme condition.

During the past 6 months four other patients[1] have entered the Johns Hopkins Hospital in a comatose condition due to intracranial tumor and in whom no information leading to the location of the tumor could be elicited either from the history of friends and relatives or from the purely objective examinations of the comatose patients. In three of these patients the estimation of the ventricular capacity alone made the localization of the tumor possible. In the fourth, both lateral ventricles were so reduced that only drops of fluid could be obtained from either side, but the ventricles were so definitely dislocated toward the right that the tumor was localized to the left cerebral hemisphere. Two of these patients are now cured after total extirpation of dural endotheliomata A third died 24 hours after total removal of a cerebello-pontine angle tumor and the fourth died of ventricular hæmorrhage 2 days after extirpation of a glioma which projected into the ventricle. Three were completed in one stage, the fourth in two stages. Possibly a two-stage operation would have been wiser in the two patients who did not recover.

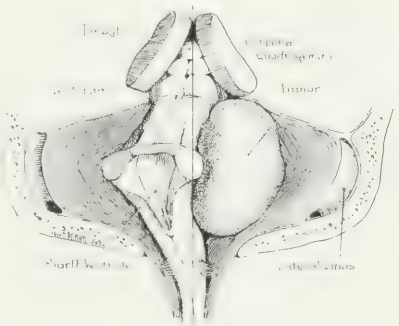

Fig. 5. Diagram of cerebello-pontine tumor located in Case 1 by ventricular estimation. The tumor has blocked the aqueduct of Sylvius causing symmetrical dilatation of the lateral ventricles: free communication between them is determined by the injection of indigocarmin into one ventricle and aspiration of the color in the other.

Case 1. *Patient comatose. Diagnosis: Brain tumor. Presumptive localization: Left cerebral hemisphere. Localization following ventricular estimation: Tumor in posterior fossa. Operative finding: Tumor right cerebello-pontine angle. Total removal; death 18 hours later.*

[1] Other comatose patients afflicted with tumor have been operated upon during this period, but they have had signs which have indicated the location of the growth. The cases here reported are all in whom the procedure has been used since its adoption.

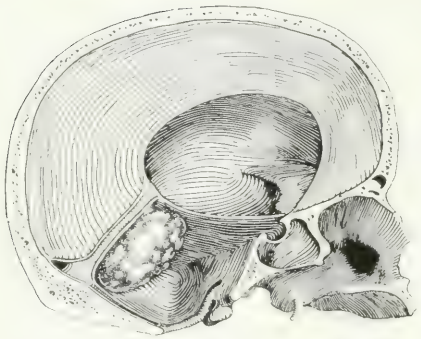

Fig. 6. Diagram to show position of dural endothelioma arising from the inferior surface of the tentorium cerebelli (Case 2). Dilatation of the lateral ventricles with free communication was determined by the ventricular estimation test. The cause of the hydrocephalus was obstruction of the aqueduct of Sylvius.

A sparely nourished woman, age 48, was seen in consultation in another hospital. For several hours she had been deeply unconscious following a lumbar puncture.

Over a period of 4 or 5 years she had complained of general headaches, perhaps greater over the vertex. These gradually increased in frequency and severity, and throughout the past 8 weeks were almost intolerable. At times, vomiting followed the severe headaches and gave a certain amount of relief. The right eye had been blind for 3 weeks, and only light perception remained in the left. During the past few weeks she had complained of a weakness of the right arm and leg. A slight facial asymmetry and weakness of the right arm had been noticed by her husband. Recently she fell when the right knee gave way. There had also been pain in the right arm at times. She had never complained of deafness or any unusual feeling in her face (involvement of nerves VIII and V). She was so deeply unconscious that the examination was entirely objective; except for a bilaterally symmetrical choked disc of 6 diopters, there was no positive neurological finding, though possibly the right side of the face moved less on deep stimulation of the surpra-orbital nerve; but the difference was not sufficiently definite to be considered positive. The reflexes were equal. There was no Babinski or ankle clonus on either side. No extra-ocular palsies could be detected; she had never complained of diplopia. The spinal fluid made at the above ill-advised lumbar puncture, contained globulin and a 4+ Wassermann. The blood pressure was 168-122; pulse 120. The diagnosis of an intracranial tumor was clear, owing to the bilateral choked disc, the long history of headaches, vomiting, and gradual loss of vision. The localization of the tumor was not clear, but from the history of weakness of the entire right side, a presumptive diagnosis of a left cerebral tumor, possibly frontal, was made. She was, therefore, draped for an exploration of the left cerebrum, but since the diagnosis was only tentative and based on the history, puncture of both lateral ventricles was first made to confirm or contradict this diagnosis. Twenty cubic centimeters of fluid was easily aspirated from each lateral ventricle and more could have been withdrawn. Indigocarmin injected into the left ventricle was quickly recovered when the right was aspirated. Such large ventricles were considered proof that our presumptive diagnosis was incorrect; that a tumor could not be present in either cerebral hemisphere and, since there was free communication between the ventricles, the neoplasm was probably in the posterior cranial fossa. The patient was then redraped for a cerebellar operation. The usual bilateral cerebellar exposure was made. A characteristic encapsulated tumor presented in the right cerebello-pontine angle (Fig. 5). Realizing that a cerebellar decompression would hardly be helpful, since the obstruction to the iter was caused by a firmly imbedded tumor which would not be affected by the removal of bone, an intracapsular enucleation was considered the only possible method of producing palliation. This was easily performed, but since her condition had remained unchanged, the removal of the capsule also seemed possible with little extra time and effort. It was, therefore, completely extirpated. There was no bleeding at any time, the individual arteries and veins being caught in silver clips. Consciousness did not return following the operation, death coming 18 hours later. In retrospect, it doubtless would have been wiser to have been content to leave the capsule in place and to complete its removal at a subsequent stage, particularly as the slightest injury to the medulla would greatly add to her danger. It is worthy of passing note that the Wassermann (4+) was of no significance and might have been very misleading.

Case 2. *Patient comatose. Diagnosis: Brain tumor. Presumptive localization: Tumor of left cerebellum or right frontal lobe. Localization from ventricular estimation: Tumor in posterior fossa. Two-stage operation: Total removal encapsulated dural endothelioma arising from tentorium cerebelli. Recovery.*

A well nourished woman of 55 years was seen in Rochester, New York, in consultation with Dr. John R. Booth. For the past 2 days she had gradually become increasingly drowsy and during the night lapsed into coma. Although no response to questions was obtainable, she still moved at times. Though the wife of a physician, she had complained so little that he could offer nothing which was helpful in making a localization of her lesion. For only the past 2 months had she complained of general headaches, intensified by defæcation. Frequently there was vomiting. For a few days there had been diplopia but this had disappeared. For 5 weeks there

had been dizziness and an uncertain, unsteady gait with possibly a tendency to deviate to the left. At times she had spoken of a weakness of the left leg and arm, but nothing suggesting ataxia or nystagmus had been observed. A severe acute infection of the right frontal sinus had immediately preceded her headaches, and this had been looked upon as the cause of her present illness. Except for a choked disc of about 7 diopters in each fundus oculi, the examination was entirely negative. No nystagmus could be elicited; there was no noticeable strabismus. No difference in the muscle tone of either arm could be detected on quickly flexing and extending the forearm. The reflexes were normal and equal on the two sides. No Babinski or ankle clonus. White blood count, 15,000; pulse, 120; temperature, 99.2°. There was little evidence upon which to differentiate between a right frontal tumor or abscess and one in the left cerebellum. The strongly emphasized frontal infection (sinuses now clear), the leucocytosis of 15,000, and the history of a weakness of the left side, were weighed against a possible history of staggering gait and tendency to fall to the left.

She was at once brought to Baltimore and sent directly to the operating room. She stood the journey surprisingly well, there being very grave doubt that she would reach the destination. The operation: 25 cubic centimeters of fluid was aspirated from each lateral ventricle. It was under great pressure. The reasoning from these data was essentially like that in the preceding case. Ventricles of such size were considered incompatible with a tumor in either cerebral hemisphere and indicated an infratentorial tumor. A bilateral cerebellar decompression was made. The left lobe was so much larger than the right that a tumor in the left cerebellar hemisphere was unquestioned. A cyst was excluded by a puncture of the hemisphere. No attempt was made to learn more about the tumor because of her desperate condition. During the next few days consciousness returned and her strength quickly followed. Had we been able to consult the patient, the differential diagnosis would not have been difficult. The staggering gait and tendency to fall to the left had not been equivocal. She had been very dizzy for some time and because of this had been unwilling to lie on the left side. She had not communicated these symptoms to her husband because of her unwillingness to worry him.

A month later, an encapsulated dural endothelioma weighing 40.5 grams (Fig. 7) and arising from the inferior surface of the tentorium (Fig. 6), was removed *in toto*. It was completely hidden from view by the overlying left lobe of the cerebellum so that it was not actually seen at the first operation. She made an uneventful recovery.

Case 3. *Patient comatose. Diagnosis: Brain tumor. Localization not presumed. Localization after ventricular estimation: Right occipital lobe. Operation: Removal dural endothelioma arising from superior surface of tentorium. Recovery.*

Fig. 7. Drawing of the tumor shown in diagram (Fig. 6). An uneventful recovery followed its removal. Weight of tumor 40.5 grams.

Patient is a well-nourished woman, age 50; referred by Dr. J. S. Horsley of Richmond, Virginia. On arrival at the Johns Hopkins Hospital she was unconscious and had been so for about 5 hours. Only very deep stimulation of the supra-orbital nerve brought response. Respirations were of the typical Cheyne-Stokes type, with breathless intervals of 40 seconds; pulse slow, full, and bounding, 60 per minute. Her present trouble began only 3 months before admission, with severe headaches on the top of the head—never more localized. In the beginning the headaches would last 2 or 3 hours and recur two or three times a week. Gradually they increased in frequency and severity and for the past month they have been almost constant. There was some pain and tenderness in the back of the head and some stiffness of the neck. She became dull and slept a great deal. Nausea and vomiting began about a month after the onset of headaches and for 2 days during the last week she vomited almost continuously. Two weeks before admission her eyes became crossed. About this time she also saw half of things, but her physician could find no hemianopsia. Dr. Horsley and Dr. Vaughan saw her for a few hours and apparently made out a hemianopsia to the left, but, as Dr. Horsley's notes had not yet arrived, our only information about the hemianopsia was brought through the husband. We had no way of knowing how definite this finding might be.

The examination showed a paralysis of the *left* external rectus (Fig. 10), the eye being turned strongly inward and a bilateral choked disc of 6 diopters. There were no differences in the reflexes on the two

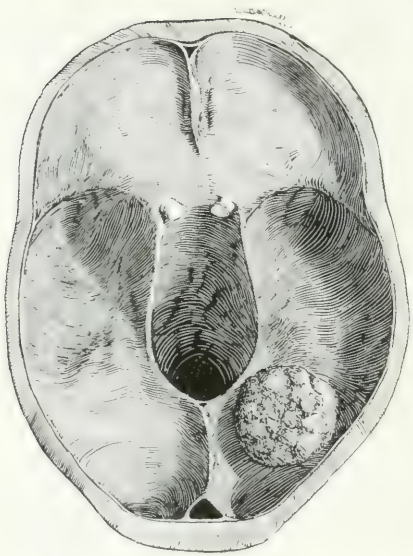

Fig. 8. Diagram to show the position of the dural endothelioma arising from the superior surface of the tentorium (Case 3). It was located by the ventricular estimation test. The tumor was completely removed; uneventful recovery.

sides, no Babinski or ankle clonus. No difference in the muscle tone could be detected. The one objective finding, therefore, was paralysis of the *left* external rectus muscle (nerve VI). The possible history of a hemianopsia to the left would not harmonize with palsy of the left nerve VI, but the value of implication of the sixth nerve is too capricious to be taken seriously. Here we should have been misled had it been considered a localizing sign. The suboccipital headache and cervical rigidity suggested the possibility of a cerebellar tumor, though no history of staggering gait could be elicited.

Bilateral ventricular punctures were attempted; the right ventricle could *not* be reached, the left ventricle was encountered in a position which did not appear abnormal, but only 10 cubic centimeters of fluid could be withdrawn. Again an attempt was made to reach the right ventricle, but again without success. We were safe in excluding a tumor of the posterior cranial fossa because there was no hydrocephalus. The inability to reach the right ventricle was presumptive evidence of a tumor on this side, especially when taken in conjunction with a fairly normal sized ventricle on the left, and if the tumor was on the right it would more probably be located posteriorly because of the closure of the posterior horn and vestibule; this part of the ventricle would hardly have been completely occluded, or at least it would have seemed less likely, from a tumor located anteriorly in the hemisphere. A presumptive diagnosis was then made of a tumor of the occipital lobe. Operation: A bone-flap was turned down exposing the posterior two-thirds of the right cerebral hemisphere. The brain under high tension quickly herniated through the dural opening. No tumor was visible, though practically the entire outer surface of the brain could be inspected. Posteriorly, however, the brain was distinctly paler than elsewhere, the convolutions were wider and the sulci so flattened that they were practically devoid of the normal mantle of cerebrospinal fluid; all of which indicated an underlying tumor. The inferior tentorial surface of the occipital lobe was then explored and about 1 centimeter beneath the outer surface, a well-rounded edge of tumor presented. A perfectly encapsulated dural endothelioma was gradually brought into view and totally extirpated without unusual difficulty. It weighed 22 grams (Fig. 9). Recovery uneventful.

Case 4. *Patient comatose. Diagnosis: Brain tumor. No localization presumed. Localization after ventricular estimation: Left cerebral hemisphere, probably occipital. Operation: Removal deeply situated subcortical glioma projecting into the lateral ventricle. Death 2 days later of intraventricular hæmorrhage.*

Patient was a well-nourished woman of 37. When first seen with Dr. L. A. Krause, she was extremely restless but unresponsive. In the interval of about an hour before reaching the hospital, she became so deeply comatose that strong supra-orbital pressure brought no response. She became cyanotic and respirations were very shallow and pulse which had been 60 to 70 quickly mounted to 140. When placed in the ventral position there was some improvement, which became so great when a ventricular puncture was done as to allay immediate apprehension and allow us to proceed with the operation.

Her history and examination were easily adequate to make the diagnosis of an intracranial tumor. Although she had suffered from headaches nearly all her life, they had become much more severe 4 months ago and had since been practically constant. The headaches have been frontal, at the vertex and occipital regions, but never confined to one side. About 4 months ago blurring vision was noticed; this became so bad that she could not read the music notes (she was a music teacher). Double vision was present at times. There had been no complaint of hemianopsia. The vision in the left eye seemed worse than the right. To see objects with her left eye, she would be compelled to turn her head around in this direction. (This was considered at the time as possible evidence of hemianopsia; the tumor's location, however, would have caused homonymous hemianopsia to the right instead of to the left).

Vomiting spells had been frequent, sometimes four or five attacks a day. Nausea was present most

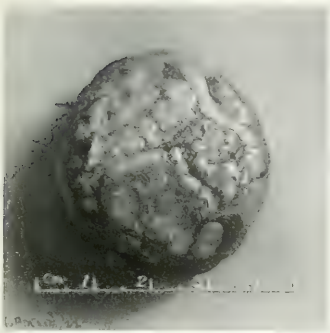

Fig. 9. Drawing of tumor shown in diagram (Fig. 8). Weight 22 grams.

Fig. 10. Showing patient (Case 3) from whom preceding tumor (Fig. 9) was removed. This photograph shows the contralateral abducens palsy which still persists at the time this photograph was taken, 3 weeks after operation.

of the time and caused great distress. A month before admission she became unconscious and remained so for an hour, but is said not to have had a convulsion. Dr. Krause, who saw her for the first time only 24 hours before my examination, made out more active reflexes on the right, but no other changes. The reflex difference was not evident when I saw her. No Babinski and no ankle clonus were present. A bilateral choked disc of 6 or 7 diopters was the only positive finding.

Attempts were made to tap both lateral ventricles but at first neither could be reached. The right ventricle was finally entered, probably 2.5 centimeters to the right of its proper position (as nearly as could be estimated from the deeply concealed tip of the needle), but only a few drops of fluid escaped and apparently under no increased pressure (when ventricles are so greatly reduced in size, the few drops of fluid which escape from the needle indicate a cavity too small to register intracranial pressure). The left ventricle was also reached far to the right. It was so compressed that no fluid escaped through the end of the needle; the only proof that the left ventricle had been reached was a few drops of clear fluid which escaped from the needle after its withdrawal. The diagnostic reasoning from these observations was as follows: the lesion could not be in the posterior fossa because there was no hydrocephalus; it was probably in the left cerebral hemisphere because both lateral ventricles were definitely dislocated to the right; the almost complete obliteration of the posterior part of both lateral ventricles, together with the great dislocation of this part of the ventricles, indicated that the location of the tumor was probably in the occipital region. Accordingly, the left occipital region was explored. Although no tumor was on the outer or inferior surfaces of the brain, an underlying lesion was indicated by the pallor and breadth of the convolutions and obliteration of the fluid-containing sulci. Transcortical exploration just back of the supramarginal gyrus disclosed a well-circumscribed tumor about 3 centimeters below the surface of the brain (Fig. 11). The position of the tumor would indicate a probable glioma, but it was extremely hard—almost of stony consistency—and seemed to separate readily from the brain tissue; moreover, a large, smooth nodule projected into the vestibule of the ventricle. For these reasons, the possibility of an ependymal tumor was considered. The most distant parts of the tumor became increasingly more fixed and less circumscribed; it was then clear that the tumor was a glioma and could not be completely removed, unless possibly after removing the main mass of tumor the outskirts could be excised later with normal brain tissue. A tumor mass weighing 105.5 grams (Fig. 12) was removed with considerable difficulty by finger enucleation leaving of course fringes of the tumor, even though invisible. The vestibule of the ventricle was opened. The bleeding was controlled after a large vein entering the vena Galena magna had been ligated. After removal of the tumor the incisura tentorii was in plain view, in fact it was here that the large bleeding vessel was "clipped." The glomus of the choroid plexus was exposed in the open ventricle. The bleeding was apparently entirely checked for some time before closure; but the possibility of a tiny ooze into an open ventricle is always the source of apprehension. Two days later she died of intraventricular hæmorrhage.

POSSIBILITIES OF ERROR FROM VENTRICULAR ESTIMATION

It is well to reiterate that there are great possibilities of error in this procedure for reasons which we shall show. It is justifiable

to disregard these possible mistakes only when the patient's condition is so serious as to preclude cerebral pneumography or when there is only a slight element of doubt of the location of the tumor which may be eliminated in this way. The whole procedure, of course, is dependent upon knowledge of ventricular topography, upon the confidence in one's ability precisely to reach the normal ventricle and in the interpretation in terms of intracranial pathology of the results of the punctures.

The first element of uncertainty lies in the great variation in size of the normal lateral ventricles. A lateral ventricle in one individual may be 4 or 5 times as large as in another. A big normal lateral ventricle may even be larger than a small hydrocephalic ventricle. From a small lateral ventricle 10 to 15 cubic centimeters of fluid can usually be aspirated, but from ventricles apparently equally normal 30 to 40 cubic centimeters may be obtained, and there are all sizes between. It is evident, therefore, that large normal ventricles may easily be mistaken for hydrocephalic ventricles, if ventricular estimation alone were depended upon for a localization of the growth. There would really be no way of making the differentiation by this method. In order to emphasize this danger, the following case in point is briefly presented. Had this patient been comatose at the time of entrance to the hospital, and if his localization had depended on ventricular estimation, doubtless a cerebellar operation would have been performed and his tumor would have been missed.

This patient was blind from intracranial pressure but had absolutely no signs of the tumor's location. The accompanying ventriculograms indicate the location of the tumor and oversize of the lateral ventricles—surely normal for this individual and not increased in any conceivable way by the tumor's pressure. Despite the great size of the tumor—143.5 grams—a dural endothelioma (Fig. 16)—this ventricle still yielded 30 cubic centimeters of fluid, an amount which would easily indicate a hydrocephalic ventricle. The tumor was completely enucleated and an uninterrupted recovery followed.

It will be seen from these ventriculograms (Figs. 13, 14, and 15), that the tip of the posterior horn extends so nearly to the surface of the brain that the ventricular needle would have to penetrate only about 1 centimeter of brain tissue to reach it. Such a finding could easily lead to the assumption that the ventricle was greatly dilated.

Probably an even greater element of error in the use of this method is in cases of hydrocephalus. Bilateral hydrocephalus may develop from tumors of the pituitary, third ventricle, pineal body, cerebellum and brainstem, or more precisely from tumors which can produce an obstruction anywhere between the foramina of Monro and the foramen of Magendie, i.e., roughly about three-quarters of the longitudinal extent of the brain. From the interpretation of the findings of ventricular estimation as just described, on the law of probability the tumor would be in the posterior cranial fossa, but a very high percentage of cases with bilateral hydrocephalus are in the middle and not the posterior cranial fossa. Tumors of the pituitary, third ventricle, and some tumors of the pineal body, can be eliminated by the indigocarmin test. The elimination of these growths (of ever-increasing importance) reduces the chances of error to the small group of tumors of the pineal and of the contiguous part of the brain, i.e., those tumors which occlude the aqueduct of Sylvius but do not close the foramina of Monro. From a practical standpoint, however, the chance of curing or even temporarily relieving a patient in coma from bilateral hydrocephalus when the tumor lies elsewhere than in the posterior cranial fossa is slight. In the presence of a *bilateral* hydrocephalus, the two lateral ventricles communicating, there is justification, from a practical standpoint, of a cerebellar exploration. And with the dye test, practically all tumors of the posterior fossa can be found at operation.

EXCLUSION OF TUMORS BY VENTRICULAR ESTIMATION

Coma resulting from other intracranial lesions simulating tumor. chronic meningitis. At times other conditions may produce coma which is very difficult or even impossible to

Fig. 11. Diagram showing position of tumor in occipital lobe (Case 4) located by ventricular estimation test. Tumor, which was a glioma, projected into the lateral ventricle. Patient died 2 days later of a slow bleeding into the ventricle.

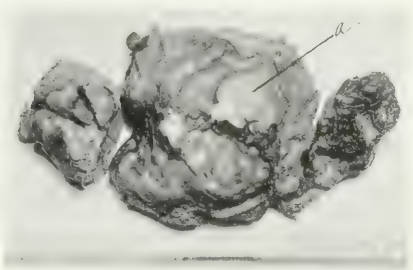

Fig. 12. Photograph of tumor from Figure 11 (Case 4). This tumor was not encapsulated and a permanent cure could not have resulted. The smooth area, *a*, is the intraventricular part of the tumor. Weight of the tumor is 105.5 grams.

differentiate from that of brain tumor. This is particularly true when coma is so far advanced that there is not time for extended examination. Such a case was recently seen in consultation with Dr. Horning of York, Philadelphia.

The patient, a large, strong man of 55 years, had been in partial coma for 48 hours. He was then deeply unconscious, though deep supra-orbital pressure brought response. The respirations were characteristically of Cheyne-Stokes type. Until 2 weeks ago, he had seemed well in every way. Bifrontal headaches beginning at that time quickly became so severe that he was forced to bed. The headaches had been practically constant and of steadily increasing intensity. When he attempted to walk his gait was like that of a drunken person and unless supported he would fall. A squint appeared about a week ago. Urinary and fecal incontinence developed with coma. A choked disc of 4 diopters completely obliterated both nerve heads. Pulse 70; temperature 99.6°; blood pressure 185-100. The urine contained a few cells and more than a trace of albumin. On two examinations previously made by Dr. Horning, a trace of albumin was found. Left cardiac dullness extended 13.5 centimeters from the midline; the heart sounds were clear. There was no œdema of the eyelids or ankles. Aside from a slight abducens palsy, the neurological examination revealed no positive findings. The reflexes were equal and normal, no Babinski or ankle clonus; no difference in the muscle tone of the two sides. There was no history of a blow on the head. There was no rigidity of the neck.

The cause of the coma was by no means clear. A cardio-vascular-renal syndrome was considered. The blood pressure of 185, trace of albumin and white cells in the urine, made a nephritic condition possible, but these findings did not seem sufficient for such profound intracranial as well as systemic changes. On the other hand, the history of headaches of only 2 weeks' duration before the onset of coma, is most unusual for an intracranial tumor. But all of his symptoms had been referable to the head, i.e., headache, staggering gait, and strabismus; these and a bilateral choked disc made an encephalopathy clear. A brain tumor seemed the most plausible explanation of all the facts in our possession and possibly a cerebellar tumor because of the staggering gait. But the evidence was not conclusive even that it was a tumor, largely because the history was too short and the symptoms and coma too fulminating (not impossibilities, however). Nor were we willing to make a positive localization to the cerebellum; staggering gait might be due to weakness, intensity of headache, or dizziness. Ventricular estimation tests showed both lateral ventricles large (25 cubic centimeters easily obtained) and indigocarmin easily passed from one ventricle to the other. The ventricular fluid was under pressure. If a tumor, it was therefore not in either cerebral hemisphere, but must be in the posterior fossa. If a tumor was in the posterior cranial fossa, the dye would not pass into the cisterna magna or the spinal subarachnoid space. A spinal puncture or an Ayer's puncture or exposure of the cisterna magna would determine the presence or absence of such a tumor. Because of the great danger of lumbar punctures and of Ayer punctures in intracranial tumors, we were forced for reasons of safety to a direct exposure of the cisterna. The presence of the dye in quantity precluded a tumor and made the diagnosis of hydrocephalus of the communicating type due to some condition other than a tumor. The cisterna magna was oversize and the cerebellar tonsils were not herniated into the foramen magnum. Both of these findings made a cerebellar tumor highly improbable. Hydrocephalus of this character is probably due to an increased production of fluid rather than to an ob-

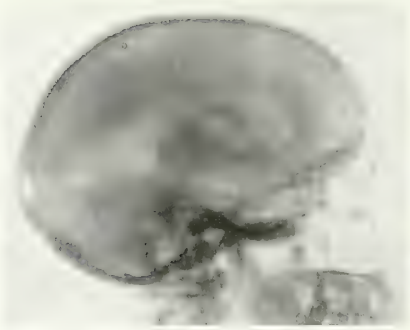

Fig. 13. Roentgenogram showing large left normal lateral ventricle in patient with dural endothelioma in the right frontal lobe.

Fig. 14. Roentgenogram showing the right lateral ventricle deformed anteriorly by indentation of the superimposed dural endothelioma. See Figure 16.

struction with decreased absorption. Possibly in this case it may have been due to a cardio-vascular-renal syndrome, though this is by no means yet clear. Death came 30 hours later. A complete necropsy was made by Dr. MacCallum. He reports a mild chronic inflammatory process along the base of the brain. The condition was doubtless, therefore, a chronic meningitis of unknown origin. Bacteria were not found. There was no tumor in the brain. However, we are concerned here only with the diagnosis and elimination of the tumor.

SUMMARY OF CASES

About 6 months ago, a left craniotomy was performed on a patient in the terminal stages of coma from intracranial pressure, presumably due to a tumor or abscess. The sole means of determining upon which side the exploration should be made was a Jacksonian convulsion beginning in the right hand. Though considered a most trustworthy localizing manifestation, it proved misleading on this occasion, for at necropsy an abscess was found in the right frontal lobe, i.e., it was homolateral to the side of the convulsion. During the operation, information was gained from the lateral ventricle which led us to the adoption of a procedure which we may call "estimation of the cerebral ventricles." Its object is to localize growths in such emergencies. The information leading to this end is derived from a determination of the capacity, location, and intercommunication of the cerebral ventricles, particularly the lateral ventricles. Since this first case, five other patients have been seen in coma from intracranial pressure. In none of them was there any information obtainable, either from the history of friends and relatives or from the restricted objective examination of the unconscious patient, which was considered of merit in determining the location of the lesion. In four of these patients the lesion was a tumor and in the fifth an acute hydrocephalus of chronic meningitis origin. In the last case, a tentative diagnosis of tumor was made but given up as a result of the "ventricular estimation" tests. Possibly an analysis of the fluid at the time might have shown an increased cell count, but unfortunately this examination was not made because the fluid was blood-stained. The Wassermann from the ventricular fluid was negative. Each of the four tumors was correctly localized by these tests and in each instance the tumor was found at operation and removed. Two of these patients succumbed on the following day and the other two, after complete removal of dural endotheliomata, recovered and are now entirely well.

SUMMARY OF REASONS FOR VENTRICULAR ESTIMATION

Three determinations are made: (1) The position of the lateral ventricles by the ventricular puncture; (2) the size of each lateral

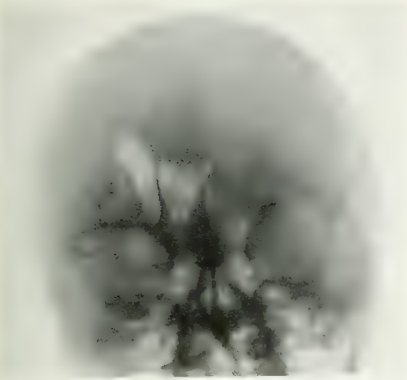

Fig. 15. Anteroposterior ventriculogram (of Figs. 13 and 14) showing the dislocation of both lateral ventricles to the left side and the marked deformation of the right ventricle from the superimposed tumor. These ventriculograms indicate large ventricles but which are still normal—a not uncommon finding. Had ventricular estimation tests been used on this patient, a cerebellar operation would doubtless have been performed and the tumor would have been missed. They are shown to emphasize the possibilities of error in this method.

Fig. 16. This tumor was removed from the patient whose ventriculograms are shown in Figures 13, 14, and 15. Except for blindness which will be permanent, this patient is well.

ventricle by measurement of amount of ventricular fluid aspirated from each lateral ventricle; (3) the communicability of the lateral ventricles (or other parts of the cerebrospinal system) by injecting indigocarmin into a lateral ventricle and then aspirating fluid elsewhere (depending on part of the ventricular system to be tested).

If we know the actual size of each lateral ventricle, we can infer, with a certain degree of accuracy, whether a tumor can exist in either cerebral hemisphere. If one lateral ventricle is small (or collapsed) and the other larger, a tumor will probably be on the side of the small ventricle (with exceptions). If both lateral ventricles are large, a tumor will probably not be in either hemisphere but in the posterior cranial fossa (with more exceptions). The exceptions are principally instances in which hydrocephalus results from tumors in the middle or even at times the anterior cranial fossa. The indigocarmin test is principally useful in eliminating and identifying these exceptions. From its use we are usually able to say whether there is any obstruction in the ventricular system anterior to the aqueduct of Sylvius. An obstruction anterior to the aqueduct of Sylvius will (with exceptions) prevent the dye from passing from one lateral ventricle to the other. On occasions, which are probably not frequent, it is necessary to know whether an obstruction exists at or posterior to the aqueduct of Sylvius; this is almost equal to determining whether a tumor or some other condition is causing the coma. For information of this character, it is necessary to inject the dye and test for its presence in the cisterna magna (or spinal canal). It is safer to expose the cisterna magna by operation than to employ lumbar puncture. It is only when both ventricles are so nearly occluded that only a few drops of fluid can be obtained, that we are forced to rely solely upon the information from a ventricular puncture. A definite displacement of both lateral ventricles will then indicate the location of the growth. It is, of course, possible even with large tumors that there may be no dislocation, or at best it will not be sufficiently marked to draw any conclusions.

I have seen such a case at necropsy: a tumor arising in the midline had grown to each side and occluded practically all of the posterior three-fourths of both lateral ventricles. This in one of the situations in which the method is defective.

SUMMARY OF ARGUMENTS FOR AND AGAINST VENTRICULAR ESTIMATION

The method is relatively simple, easily performed, relatively harmless, and requires very little time. The principal danger to life is in puncturing an intraventricular tumor and thereby causing death from intraventricular hæmorrhage. Though this is always an actual danger, it is not deterrent when we consider the magnitude of the problem of saving an unconscious patient. It requires very little, and at times no extra, time, but the relief of intracranial pressure by release of fluid is more than compensatory. The greatest drawback is the possibility of an incorrect localization. Were it not for this very great element of error (described above), the procedure could be used as a substitute for cerebral pneumography. But the element of error is of such magnitude that the procedure should be used only in emergencies, where the more precise methods would add danger to an already overstrained intracranial tension. I am not so certain that in time it may not appear advisable to use it in cases of hydrocephalus, but at present this does not seem indicated. There are many instances where we could have made the correct localization of an intracranial tumor by this method and spared the patient discomfort and a certain degree of danger, but there are other tumors which would surely have been missed at operation had it alone been employed. The treatment of brain tumors is always too serious and too all-dependent on a precise localization, to run the risks of an incorrect operation based upon a mistaken diagnosis which has been made with even an element of chance or guesswork.

CRANIAL AND INTRACRANIAL ENDOTHELIOMATA—HEMICRANIOSIS

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INTRODUCTION

TUMORS of the type described in this paper were first called to my attention by Mr. Percy Sargent. It was my privilege to assist him in the removal of an intracranial tumor which was associated with a lump on the overlying cranium (see Case 9). After operation, the case was shown to the Neurological Section of the Royal Society of Medicine, February 10, 1921. This led me to search the records of the National Hospital for any other possible instances of the association of intracranial neoplasm with exostoses of the skull.[1]

The reports of 420 patients who had been proved to have brain tumors at operation or autopsy were examined. Ten cases were found to have a hard prominence of the skull which had been noted on admission. In each case the intracranial tumor was situated immediately beneath the prominence. In 8 of these cases, there was a report of microscopical examination, and the specimens from one of the remaining two cases were found and sections cut. (A case of sarcoma perforating the skull produced a lump on the cranium. It did not resemble this group because the lump was soft and could be pressed inward through the skull. It was therefore not included.)

Of the 9 cases with microscopical examinations, 7 were operated upon by Sir Victor Horsley and 2 by Mr. Sargent. To my surprise, all presented the same histological picture and similar clinical courses. They seem to form a definite variety of tumor which frequently should be diagnosed before localizing cerebral symptoms appear. The end-result of those cases that survived operation is very encouraging. For this reason it is important that this type of brain tumor should be generally recognized.

Nine similar cases with histological examinations of at least the *intra*cranial part of the tumor have been collected from medical literature. These include cases called hemicraniosis by French authors.

Case 1. H. P., a woman of 41, was admitted to the National Hospital, Queen's Square, London, in 1906, under the care of Dr. Risien Russell. There was no history of injury, but for 10 years she had noticed when she combed her hair, a steadily increasing "hard knot" on her head. For 12 months she had complained of headaches referred to this lump, and for 6 months very severe, darting and stabbing pains referred to the same location. These sharp pains came on two or three times a week, usually in the morning. For 6 months there had been attacks of giddiness and fainting. At these times "the room seemed to go around."

Dr. S. A. K. Wilson made the following note on her admission. "Small, poorly nourished woman. On the left side of head growing from cranial vault is a large, hard, rounded mass which passes insensibly into surrounding bone (see Fig. 1). It is covered with hair except anteriorly where the cutaneous veins of the scalp . . . are larger than is usual. The mass is absolutely hard and quite painless when knocked. Its situation is chiefly over the upper posterior part of the left frontal bone. Its circumference at the base is 14½ inches, the greatest coronal arc 6½ inches and the greatest sagittal arc 6⅜ inches." There was no lesion of the cranial nerves and physical examination otherwise presented no departure from the normal.

Operation by Sir Victor Horsley. A scalp flap was turned back, a trephine opening made at the side of the bony tumor, and a double cut made with a hand saw all the way round the growth. The mass was then broken free and forcibly removed, including a rim of what appeared to be normal calvarium. In the process of removal, the underlying dura which was thickened and discolored, was torn. It had been adherent to the concave surface of the bony tumor. The convolutions of the brain seemed perfectly normal. A drain was inserted and the wound closed. There was no subdural tumor after removal of dura.

Postoperative course. After the operation the patient's condition was critical and she became for a time aphasic. This rapidly cleared up, however, the wound healed perfectly and she left the hospital without any abnormal physical signs. May 13, 1921, 15 years after the operation, the patient was visited

[1] It is due to the generous scientific spirit of the attending staff at the National Hospital for Paralysed and Epileptic, Queen's Square, London, that this study is made possible. I am particularly indebted to Dr Greenfield, Director of the Pathological Laboratory, for putting at my disposal specimens preserved in the museum, and for his advice and friendly help in preparing the material. It was thus possible to supplement the pathological reports and especially to decalcify and examine the bony tumors microscopically, many of which had not been so examined.

Fig. 1

Fig. 2

Fig. 1. Case 1. H. P. before operation. (Kindness of Dr. S. A. K. Wilson.)

Fig. 2. Case 1. H. P. in 1922, 16 years after operation.

and the following postoperative story obtained. On returning to her home, a small village where her husband was a laborer, she was able to take up her work as well as formerly, and said she "had nothing the matter with" her. One year after the operation, she began to have "fits" in which her "face went crooked," she fell to the floor, foamed at the mouth, and had a general convulsion. These attacks became less frequent and 3 years before the interview they stopped altogether. Four years ago she became blind. In a personal communication, Dr. P. H. Adams of the Oxford Eye Hospital, who had examined her in 1917, states "she had undoubtedly had chronic glaucoma, which would account for the atrophy of the discs and blindness." She has complained of headaches beginning about a year after the operation. These headaches are most troublesome when she gets up in the morning. Stooping over brings on a headache and assuming an erect attitude relieves it.

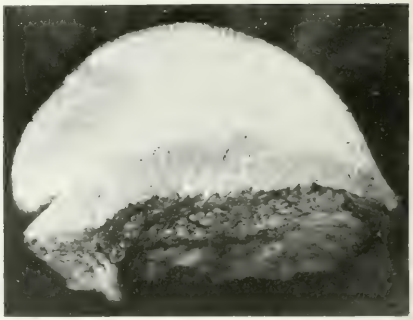

Fig. 3. Case 1. Infiltrated bone cut in half. The cut surface is 5 centimeters high by 6.5 centimeters wide.

Examination showed her to be an active elderly woman whose intelligence and speech, were normal (see Fig. 2). She was quite blind but moved about the room with considerable assurance. She is able

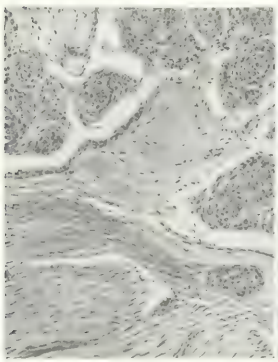

Fig. 4

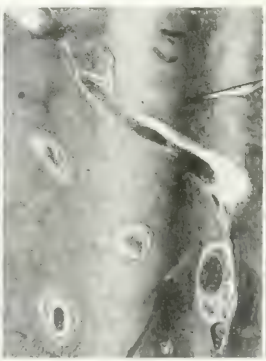

Fig. 5

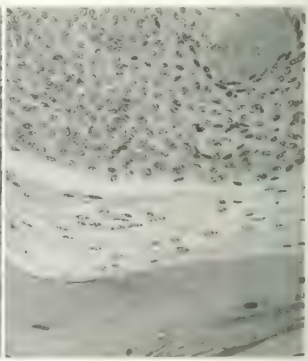

Fig. 6

Fig. 4. Case 1. Drawing showing exophytic growth above skin (cut) level.

Fig. 5. Case 1. Tumor cells in the canals of the bone, which is everywhere eburnated.

Fig. 6. Case 1. Drawing of external surface of the cranial loss. Note the layer of cells between bone and neoplasm.

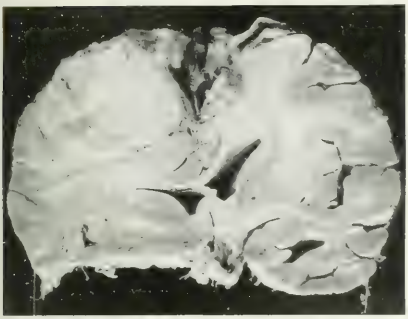

Fig. 7. Case 3. Circumscribed endothelioma attached to falx and encroaching on both hemispheres.

to do much of her work. Over the left frontoparietal region is a large area corresponding to the original removal of bone. There are some irregularities of the edges of the bony defect and at one point may be felt a rim with a shelving margin about 1 inch in width. The scalp over the defect is depressed and relaxed. Physical examination showed nothing abnormal in other respects.

Pathology. The tumor removed from the cranium at operation appeared to be dense bone. Its weight was 575 grams and greatest thickness 5¼ centimeters. It passed off into normal skull in places; in others, it overlapped the external table. After cutting through it with a saw (Fig. 3), the central part of the tumor was seen to be somewhat more dense bone than the normal skull. Part of the removed dura presented on "its outer surface a pinkish, gelatinous, tumour-like mass, a few millimeters in thickness."

Microscopic examination of this area of dura showed the whole membrane infiltrated with typical endothelioma, consisting of oval nuclei arranged in concentric whorls. Tumor was heaped up on one side of the dura. It is not certain which side. Figure 4 is a drawing of this area. The septa of the tumor seem to be continuous with the tissue of the dura. Pieces of the bony tumor were decalcified and stained (Fig. 5). To quote from the pathological report, it was apparent that "all the canals of the bone contained portions of tumour identical with that growing on the dura mater." Where the haversian canals were cut lengthwise, the endothelioma cells appeared as strands or columns. On the external surface of the bone there were numerous cup-like excavations which were filled with plugs of neoplasm. Figure 6 shows the surface of the floor of such a cup. Between neoplasm and bone is a layer of what appears to be connective tissue. If bone formation was in progress, as seems almost certain, it was taking place beneath this layer of cells.

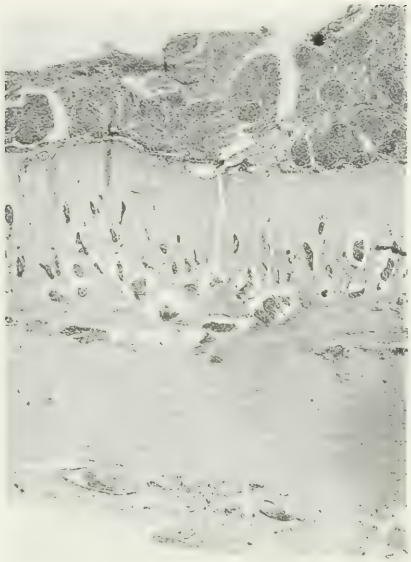

Fig. 8. Case 4. Endothelioma adherent to dura and passing through it. A connective-tissue septum may be seen attached to dura and passing through the neoplasm.

In *summary*, for 10 years the patient had had a gradually increasing horn-like tumor of the skull which reached the size of a baseball and which was composed of compact bone. The osseous canals were filled with cells identical with those infiltrating the dura beneath. These cells in form and arrangement resemble those of the usual dural endothelioma. Between bone and neoplasm may be made out a layer of cells resembling connective tissue. There was no large subdural growth in this case. The preoperative symptoms were headache and stabbing pain referred to the tumor and probably due to the effect of the growth on the dura. There were also attacks of vertigo.

After operative removal, complete relief of symptoms was followed by epileptiform attacks which disappeared. Blindness coming on 11 years after operation may be fairly attributed to chronic glaucoma. At present, 15 years after operation, she is suffering only from the headaches caused by change of position and attributable to the large cranial defect.

Case 2. R. H., a man 48, was admitted to the National Hospital in 1899 under the care of Dr. Beevor. A note was made by Dr. James Collier that for 3 years the patient had observed a gradually in

Fig. 9. Fig. 10

Fig. 9 (at left). Case 5. C. H. before operation.
Fig. 10. Case 5. C. H. twelve years after operation.

creasing swelling on the left side of his head. For 5 months before admission he had had generalized headaches and for 3 months gradually increasing dimness of vision, and he had been told he had optic neuritis. During the last 2 months he had had four attacks of "giddiness" followed by transient weakness on the right side and difficulty in speech.

There was a hard symmetrical tumor, which appeared to be part of the skull, situated in the anterior part of the left parietal region.

Operation. Mr. Victor Horsley removed the bony tumor.

The specimen was preserved by Dr. J. S. Risien Russell, then pathologist, and a note made by him that "at operation the growth was found to have penetrated the dura. The subdural growth was not removed. The symptoms completely disappeared and the patient was apparently quite well 8 months after operation." The specimen was labeled in the museum catalogue "endothelioma of the skull."

Repeated efforts to trace this patient have met with no success.

Pathology. The bone was removed from the mounting fluid, decalcified and cut. It is porous and made up of trabeculæ of dense bone which interlace without definite pattern, like the partitions of a sponge. The arrangement resembles closely that seen in a number of cases reported below. The canals and cavities are filled with what appears to be connective tissue. But in other parts the tissue is much more cellular. It is not possible, however, to say with certainty from the microscopic picture whether or not the cells resemble endothelioma. This is probably due to the fact that the specimen had been 23 years in preservative. The architecture of the bone is the same as that seen in the proven cases however, and the specimen was labeled endothelioma (presumably after microscopic examination); there was a subdural growth associated with

Fig. 11. Case 6. Roentgenograph of frontal bone. Spicules of bone have formed in the tumor.

it, and the clinical history resembles that of the other cases reported. It seems, therefore, fair to assume that the bone was infiltrated with endothelioma and to include it here.

Summary. A man, age 48, had noticed a gradually increasing swelling in the left temporal region, with headaches, increasing dimness of vision, and attacks of transient right hemiplegia associated with aphasia. The bone only was removed leaving the subdural tumor, and the patient was well 8 months after operation. There is little doubt that it was an endothelioma, although detailed histological description cannot be given.

Case 6. J. F., a man of 37, was admitted to the National Hospital in 1890 under the care of Dr Bastian. The patient had noted a swelling in the right frontal region for 10 years. During the same period of time he had had "fits," and latterly had developed left hemiplegia and some difficulty in speech. The swelling had become somewhat tender.

The following note was made by Dr. James Collier: "On the vertex of the cranium is an elevated area about the size of a five-shilling piece; firm but not tender on pressure. This is situated more on the right side than on the left of the middle line and just behind the situation of the anterior fontanelle."

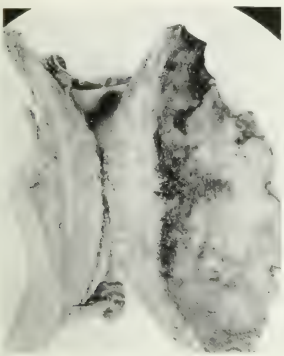

Fig. 12.

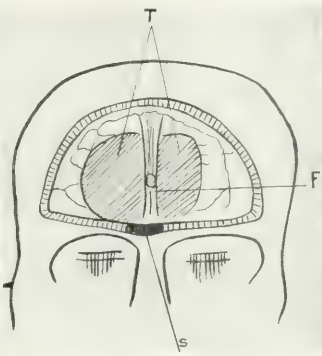

Fig. 13.

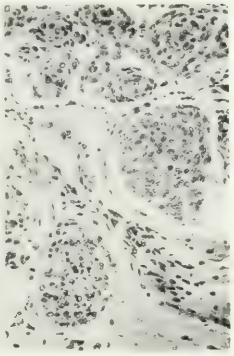

Fig. 14.

Fig. 12. Case 6. Frontal bone bisected through the tumor area.

Fig. 13. Case 6. Sketch which was found on operative note by Sir Victor Horsley and which shows the following findings: t, tumor as exposed in second stage of operation, attached to f, falx; s, frontal sinus.

Fig. 14. Case 6. Section from intracranial portion of tumor.

Operation by Mr. Victor Horsley. Stage 1: January 10, 1899. Scalp flap turned down exposing tumor in bone. Two trephine holes made. Stage 2: February 1. Removal of large piece of bone infiltrated with tumor. "Exposed growth in midline lying on dura . . . size of half a tangerine." This was removed, leaving the dura and neoplasm beneath it. Stage 3: February 6. Removal of a large tumor which penetrated down to the right of the longitudinal sinus and was adherent to the right frontal lobe. No further notes were made, but the patient died 12 days after the last stage.

Pathology. The following report was found in the postmortem register: "Large tumour involving and growing from the dura mater extending 4 centimeters into the left cerebral hemisphere, on the right about 3 centimeters. The growth is firm and hard and not very vascular, circumscribed, and does not infiltrate the brain substance. It is 13 centimeters in longitudinal direction, 8 centimeters transverse, 4 centimeters greatest depth."

The report of microscopical examination made by Dr. Batten is as follows: The tumor consisted of spindle cells with large nuclei and irregular and indefinite alveolar arrangement—variously designated "cylindroma," "endothelioma." A slice of the brain was found preserved in the museum, a photograph of which was obtained (Fig. 7).

Summary. A bony tumor situated on the vertex of the skull and extending more toward the right than the left had been present for 10 years, associated during that time with increasing neurological evidence of intracranial tumor. The tumor, which microscopically was reported as an endothelioma resembled this type of tumor by appearing to arise from the dura of the falx and by invading both cerebral hemispheres without infiltrating nervous tissue. No sections were made of the *bony* tumor, but it was reported by the operator to be infiltrated by the underlying growth.

Case 4. E. D., a woman, age 36, was admitted to the National Hospital under the care of Sir William Gowers, in 1908. Two years previously the patient had noticed, when combing her hair, a small, hard lump on her head. For over 7 years the patient had had frequent neuralgic pain in the head, not localized nor bearing any definite relation to the tumor. She sought medical advice only because, being a certified nurse, she was anxious to discover the nature of the lump. The following is from a note by Dr. Foster Kennedy: The tumor is the "size of a large plum and encroaches on the posterior aspect of the right parietal bone. It is hard and inelastic except at the anterior and outer corners where it is resilient and painful on pressure. The skin is freely movable over it."

Operation by Sir Victor Horsley. A scalp flap was made, the periosteum stripped and a trephine opening made in the skull behind the tumor. With saw and chisel a groove was made around it and the bony plaque lifted out. Below this lay a large mass of tumor infiltrating the dura. This was removed with the involved dura. Parts of two large veins on the underlying brain were removed and the ends ligated.

The patient bore the operation badly. Two days later hemiplegia developed, complete in the left arm and partial in the left leg. This became rapidly better, however, and on discharge the patient had a slight limp. Repeated efforts to trace the patient recently have been without avail.

Pathological report. The piece of bone removed was roughly oval in shape. On the external surface

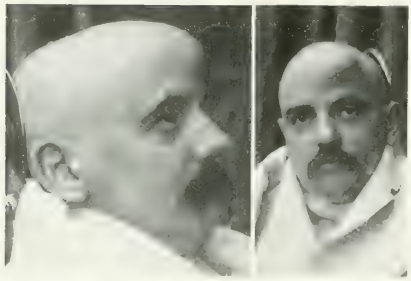

Fig. 15 Fig. 16

Fig. 15, at left. Case 7. J. B. before operation.
Fig. 16. Case 7. J. B. before operation.

was a well marked lump the diameter of which was about 5 centimeters. The edges of the lump merged gradually into surrounding bone. "The pericranium was not apparently involved in the growth. The inner surface of the bone presented a very curious, pitted and worm-eaten appearance . . . In the center of the piece of dura removed, was a flattish, granular plaque of new-growth lying chiefly on the cerebral side of the membrane. On the cranial side of the dura, the membrane was moderately thickly studded with small granular deposits of growth."

Microscopic examination of the dura (Fig. 8) shows a layer of tumor lying on that membrane. The tumor is quite cellular, the nuclei for the most part ovoid, often arranged in whorls. The general microscopic appearance is quite typical of what is generally called a dural endothelioma. There are frequent layers of spindle-shaped cells. Connective-tissue septa may be seen passing through the growth, which are continuous with the tissue of the dura itself. The vessels are included in these septa. The dura is penetrated by strands of neoplasm but is not diffusely infiltrated. Some of the tumor cells are to be found in the vascular layer on the other side of the dura.

Summary. A woman of 36 had noticed a gradually increasing cranial boss for 2 years. There were no symptoms referable to the lump. For 7 years she had complained of generalized neuralgic headaches. The bony tumor was removed, and likewise a large, underlying endothelioma, infiltrating the dura but not brain. She left the hospital with a limp remaining from postoperative hemiplegia, but has not been heard of since.

Case 5. C. H., a man of 24, was admitted to the National Hospital under the care of Sir William Gowers. For 10 years before admission he had complained of attacks of pain in the right eye which had become more severe recently. For 2½ years he had observed a swelling of the right temple which increased in size, and which he thought to be a boil at first. It was tender to pressure for about 6 months and then was noted to be bony and no longer tender. For 1 year there had been right proptosis; for 2 months transient diplopia.

A note by Dr. Foster Kennedy describes the swelling as "apparently a bony tumour" (Fig. 9). Over it "the skin is tightly stretched with dilated veins. It is regular in outline, rises one-half inch from the general plane of the skull, and extends from the right external angular process to within one-half inch of the pinna. It is not discolored and only slightly tender to touch." The right eye was displaced downward forward, and outward and there was 5 dioptres swelling of the right optic disc. The physical examination showed the patient to be otherwise normal.

Operation by Sir Victor Horsley. Stage 1: A scalp flap was turned down and the tumor with about one-half inch margin of bone was removed with trephine, saw, and rongeur forceps. "Two bosses of growth (bony) were growing from above into the orbit and were removed together with the orbital plate of the frontal bone. This involved the removal of the upper and outer portion of the orbital foramen. The eye was retracted upward and the malar bone with a portion of the superior maxilla, which appeared infiltrated with tumor, was removed. The dura was seen to be involved, "being covered with pluques of growth." These were cauterized with pure carbolic acid and the scalp flap closed. Stage 2: Five days later the wound was reopened, the cranial defect enlarged, the area dissected off, and a "protruding mass" shelled out with the finger. After some leakage of cerebrospinal fluid, the wound healed well and the patient made a "good recovery."

After operation. In May, 1921, 12 years later, the former patient was found to be actively engaged in his occupation, that of bank accountant, in London. He had returned to this work after 3 months' holiday. He complained of no headaches, no muscular weakness, no syncope, and his mental energy seemed in no way impaired. He walks 20 to 30 miles for recreation, rides a motor cycle, and has no complaints whatever.

In the right temporal fossa, there is a depression (see Fig. 10) surrounded by a smooth rim of bone. The gap is 8 centimeters anteroposteriorly and 7 centimeters up and down. A large part of the roof of the orbit is missing, leaving a gap of 5 centimeters in the orbital margin. There is no strabismus nor exophthalmos. On looking to the right, there is a very fine counter-clockwise nystagmus. On looking to the left, there is a very fine, lateral nystagmus with quick phase to the left. On convergence, the left eye tires at about 6 inches and deviates outward. Only a few fibers of the right temporal muscle contract. There is weakness of the facial muscles on the right. Apparently, he was otherwise normal.

Pathology. The bony tumor, including the outer margin of the orbit and covered on one side with temporal muscle, weighed 140 grams. Its thickness from within out was 1 inch. From the second stage of the operation, the specimen was a large oval tumor of the consistency of brain, 3¼ inches by 2¾ inches

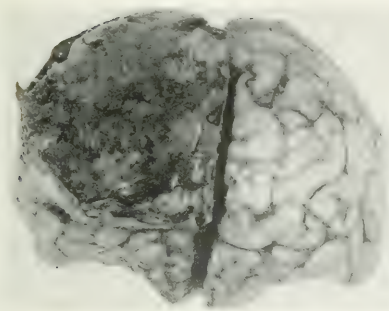

Fig. 17

Fig. 17. Case 7. Neoplasm spread over left frontal pole. Dura has been removed except where it is attached to tumor.

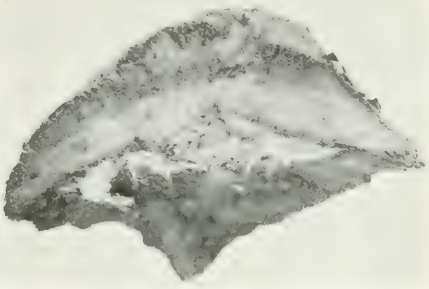

Fig. 18

Fig. 18. Case 7. The bony tumor, quite cellular at apex, has been sawed in half. White dura adherent to under surface.

by 1½ inches and weighing 107 grams. "The whole was covered by pia mater" and dura was attached to the mass at one end.

Microscopically, the tumor was reported to be a "typical endothelioma." The sections, which were preserved, show the canals of the bony tumor to contain one or more blood vessels each, together with cells whose nuclei vary from oval to spindle shape and which appear to be identical with the cells of the intracranial endothelioma. The temporal muscle is likewise invaded by these cells.

Summary. Young man complained of pain in right eye 10 years, of a hard tumor in the right temporal fossa 2½ years, right exophthalmos 1 year, and right papillœdema. By operation in two stages, a bony tumor filling the temporal fossa and entering the orbit was removed, and a large encapsulated intracranial tumor shelled out. Both were adherent to the dura. Microscopically, the tumor corresponds to the type usually called dural endothelioma. Temporal muscle, bone, and dura were infiltrated with growth, but not brain, although the tumor had displaced a considerable amount of brain. Much bone had been laid down in the extradural growth of the tumor. Twelve years after operation, the patient has no complaints and shows no evidence of recurrence.

Case 6. H. M., a boy of 18, journalist by occupation, was admitted to the National Hospital in 1910, under the care of Dr. Risien Russell. For 1 year he had complained of headaches just above the eyes. Recently he had noticed "mistiness" in both eyes. For 1 month there had been severe vomiting. He believed his forehead had changed in shape.

There was a smooth, rounded, mesial prominence on the patient's forehead, with a diameter of 2 inches, not tender. The lateral roentgenogram shows the outer table of the frontal bone and superimposed on this, lines of increased density radiating outward at right angles to the surface of the skull, suggesting spicules of bone (Fig. 11). He was described as "intelligent, memory and attention good, no decrease of mental powers." Vision was reduced to 6/36 in both eyes, bilateral papillœdema. Examination showed him to be otherwise normal.

Operation by Sir Victor Horsley. An incision was made from one temporal fossa to the other. The scalp flap thus made was turned down over the face. The scalp was adherent to the growth. After a trephine opening was made, the tumor was encircled with saw cuts (hand-saw), leaving about 1 inch of normal bone about the tumor. The frontal bone was thus removed *en bloc* down to the orbital ridges (Fig. 12). The dura was described as white and opaque over the right frontal lobe, but no mention was made of whether or not it was adherent to the bony tumor. A plug was left in the left frontal sinus and the scalp flap closed.

Seven days later the wound was opened. The dura over both frontal lobes was incised and reflected to the midline. Projecting into the brain "but with a fairly clear margin, a tumor was seen . . . It extended 2 inches to the right and 1½ inches to the left (Fig. 13). It appeared to be attached to the falx." After ligation above and below, that part of the falx was removed along with the tumor which was soft and colored a bright yellow in parts. It appeared to extend through the frontal lobes to the floor of the anterior fossa. A "plug" was left in the frontal sinus and another in the cavity caused by the removal of the tumor.

After the operation, the patient made an excellent immediate recovery. The wound however began to discharge pus. He became mentally irresponsible, imagining impossible things. He was likewise obstinate and lost his initiative, although his memory seemed unimpaired when he was carefully examined. He died 7 weeks after second stage of operation.

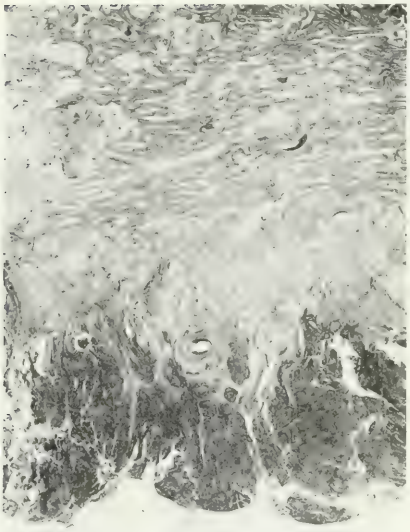

Fig. 19. Case 7. Endothelioma cells may be seen in the canals of the bone. The layer of cellular tumor is on the internal surface of the bone.

Pathology. The frontal bone "is evidently infiltrated by growth" . . . "The intracranial aspect is smooth," the inner table appearing normal. "The outer table is, to a certain extent, lost in the growth (Fig. 12), but its general outline can be followed, and projecting outward at right angles to the outer table are spicules of bone closely set, and among them apparently new-growth. The outer surface of the bone is smooth."

The intracranial tumor weighed 100 grams. It "was not encapsulated and had evidently infiltrated the brain tissue. Part of the growth was of a yellow color and was extracerebral, and seemed to be covered by a thin membrane." The tumor was adherent to dura, and a nodule of growth had penetrated this membrane.

Portions of the bone were decalcified for microscopical study, as well as blocks of the soft tumor, and the pathologist's report is "typical endothelioma which had infiltrated the bone and frontal lobes." Sections of the bone could not be found for re-examination, but sections of the soft tumor show cellular areas (Fig. 14), where the nuclei vary from round to spindle shape and blood vessels are numerous. Other areas are myxomatous, especially at the periphery, where in one section there is a definite lining membrane. This suggests that the intracranial tumor may have been wholly encapsulated.

Fig. 20. Case 7. Photograph of section from central bony portion of tumor.

Because of its soft consistency, however, it would have been difficult to remove the growth intact in its capsule.

Summary. A boy of 18 complained of pain above the eyes for 1 year, and vomiting for 1 month before admission. He had failing vision and bilateral and choked disc. A hard symmetrical prominence on his forehead was found to be endothelioma, in which radiating spicules of bone had been laid down, as shown by roentgenogram and pathological examination. The scalp was adherent. One cannot be certain whether or not it had been invaded. The dura bore some endothelioma on its outer surface and was adherent to a large intracranial growth of the same nature, which invaded both frontal lobes and seemed to arise from the falx. This tumor was partly encapsulated. Whether or not it actually infiltrated brain substance seems doubtful. Death from sepsis may perhaps be attributed to the fact that it was necessary to open the frontal sinuses.

Case 7. J. B., a man of 47, was admitted to the National Hospital under the care of Dr. Risien Russell, in 1911. Seventeen years before admission he had had a heavy blow on the head with a bar of iron. For 10 years he had noticed a swelling of the left frontal region which gradually increased in size. During the past year he had complained of frontal headaches. During this time he had become slack in his work and found difficulty in writing. Shortly before admission he became dull, unsteady in gait, and was reported to have acted strangely.

He presented a "large, almost hornlike prominence on the forehead to the left of the midline, which shelves backward and to the right for about $2\frac{1}{2}$ inches. The swelling is hard and not tender to any marked degree." His speech was slow, hesitant and explosive. He had "optic neuritis," but whether in one or both eyes is not mentioned. No other abnormal physical signs were noted (Figs. 15 and 16).

Operation by Sir Victor Horsley. The scalp was adherent to the tumor and there was much oozing of

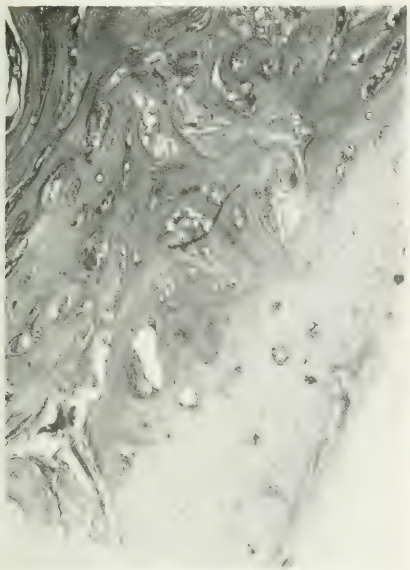

Fig. 21. Case 7. On the right the skull is beginning to appear normal.

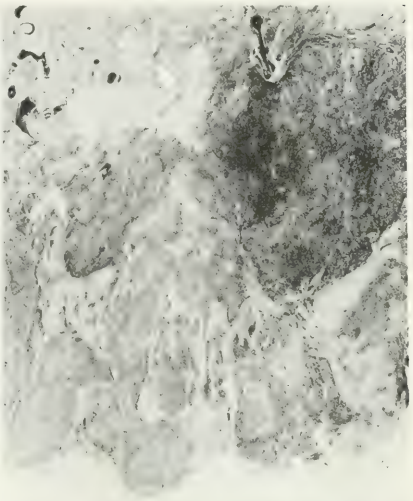

Fig. 22. Case 7. Photograph of external portion of tumor where there is more endothelioma and less bone.

blood after the flap had been turned down. The bony prominence was encircled by double saw cuts, made with a hand saw, and was then broken free, together with a surrounding margin of one-half inch normal bone. The dura was densely adherent to the under surface of the bone thus removed. This adherent area, as it was presented on the exposed dura, was 2 inches by 1½ inches and appeared as a "dark red fungating mass. There was a good deal of oozing of blood from it also." This area was burned with pure carbolic acid and the wound closed.

Death followed a few hours later.

Postmortem examination showed a "sessile, fungoid mass passing through the dura at the left frontal pole (Fig. 17), of a dark reddish color and about 2¼ inches in diameter." After the brain was hardened, the dura was removed. The mass, which was bounded on one side by the superior longitudinal sinus, came away with the dura leaving the frontal pole excavated but free from growth. Transverse sections showed the structures of the left hemisphere to have been displaced backward.

Microscopic sections of this case had been preserved. The intracranial tumor removed at autopsy is moderately cellular and is endothelioma in type. There are many spindle and oat shaped nuclei whose nuclear ground substance stains more darkly than that of the oval nuclei. The tumor is only moderately vascular, there are numerous whorls and the palisade arrangement of cells is frequent.

The bony tumor was found among the pathological specimens. In bi-section dense bone may be seen at the base, 4 centimeters in thickness. On top of this is heaped tumor and bone about 2 centimeters in thickness. Dura and a small nodule of tumor were found adherent to the under surface of the bone. Under the apex of the growth is an area where the bone is less dense. This extends through to the inner surface.

The splendid sections of decalcified bone, prepared while Dr. Hinds Howell was pathologist, show that on the inner surface (Fig. 19) is a layer of tumor whose cells resemble those of the intracranial growth described above. Next to this the bone is infiltrated with these cells. The haversian canals are filled with endothelioma (Fig. 20). Passing laterally to the area where the thickness of bone approaches that of the normal skull (Fig. 21), the canals filled with growth disappear. In the external part of the tumor, the summit of which was reported as adherent to the scalp, the amount of neoplasm in proportion to the amount of bone is greatly increased. Here spicules and irregular islands of bone are scattered throughout the growth (Fig. 22). For a higher magnification of this same area, see Figure 23, where an island of bone has been laid down in the substance of the tumor.

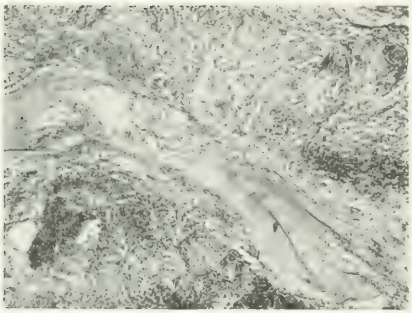

Fig. 23. Case 7. Same area as that seen in Figure 22. An island of newly forming bone.

It may be seen that this island of bone is not directly in contact with the typical cells of the endothelioma, but that there are on the surface of the bone, cells with elongated nuclei presenting a different appearance. A higher power drawing was made of the surface of such a bit of newly formed bone (Fig. 24). It is apparent that the bone is being laid down under this layer of cells, which resemble connective-tissue cells and which are apparently continuous with the connective-tissue septa that extend outward into the substance of the endothelioma. To judge from these sections, bone is being laid down in the tumor itself by the same type of cell that we call osteoblasts, as seen in repair of bone.

Summary. A man of 47, with a history of 10 years' growth of a hard, insensitive tumor on the left forehead, complained of frontal headache for 1 year. There were mental changes and difficulty in writing. At operation a large, flat, fungating, red tumor was exposed, attached to the dura and displacing but not infiltrating the brain. This was continuous through the dura with the growth on the exterior, which had infiltrated the skull and in turn become partially ossified. At the summit of the cranial boss was a plaque of tumor cells, containing only an occasional island of bone and apparently infiltrating the scalp. The patient died from the immediate effects of operation.

Microscopically, the tumor was a so-called dural endothelioma, and it filled the canals left in the newly-formed bone. Between bone and tumor may be seen connective tissue or bone cells.

Case 8. E. H., a man, was admitted to the National Hospital under the care of Dr. Batten. For 1 year he had noticed a lump in the left temporal fossa and during that time had complained of headaches, at first localized near the lump, and later becoming generalized. He had experienced diplopia for 2 months and reported one attack of numbness of the right face which was associated with weakness of the left arm and leg which passed off in a week's time.

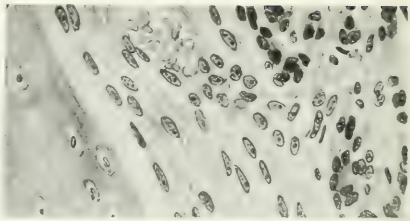

Fig. 24. Case 7. Drawing showing the surface of a newly formed island of bone at left, cells of the endothelioma at right, and between the two a layer resembling connective tissue.

The patient presented, as described by Dr. F. M. R. Walshe, double proptosis which was more marked on the left side. There was "optic neuritis" and lower facial weakness on the right. "The left temporal fossa is completely filled out and is seen as a round bulging prominence. The skin over this is normal in appearance and mobility, and the surface of the swelling is regular and smooth. On palpation, the mass is hard and does not fluctuate. On pressure there is slight tenderness." This tenderness seemed to be in the muscle itself. The intelligence was reported as mediocre. The Wassermann reactions in blood and cerebrospinal fluid were negative. Lumbar puncture gave rise to immediate vomiting and collapse.

Operation by Mr. Percy Sargent. A scalp flap was turned down. The temporal muscle was found to be invaded by "pale lobulated growth." The bone of the temporal fossa was thinned in parts, vascular, and bled freely. A large piece of infiltrated bone was removed. The surface of the dura bled so freely that it was packed and the wound closed without the dura having been opened. Death followed in 36 hours.

Some "pieces of skull with growth attached" are recorded as having been received in the pathology laboratory. The specimens were found preserved in formalin. Microscopical sections show that the bone is porous. The spaces are filled with typical endothelioma. In the tumor masses, the cells are frequently arranged in whorls. Their nuclei vary from a large, round shape to elongated forms. At the periphery, small islands of what appears to be new-formed bone may be seen. These islands are separated from the tumor cells by an intimate covering of cells resembling connective tissue and apparently identical with the connective-tissue framework of the neoplasm.

The report of the postmortem examination is as follows: "In the anterior part of the wound, the skull is evidently infiltrated with growth and the upper wall of the orbit is similarly infiltrated. A large, soft, flattened mass of tumour lies over the frontal area of the left hemisphere."

Summary. The patient had observed a lump in the left temporal fossa for a year and complained of

headache focused on this area. There had been diplopia and an attack of transient hemiplegia. At operation the muscle and bone of the temporal fossa were found to be infiltrated with endothelioma. Death followed operation and further examination showed a layer of tumor lying over the hemisphere beneath the dura. The bone which is porous is separated from the infiltrating neoplasm by connective tissue.

Case 9. W. W., a man of 45, was admitted to the National Hospital under the care of Dr. Hinds Howell in October, 1920. For 2½ years he had noticed a lump on the left side, following a fall from his bicycle; but he believed there had been a "bit of a lump" there since childhood. He had become dizzy and fallen from his bicycle several times in the past 2½ years. For 9 months he had had numbness in the right leg and hand. For 6 months before admission he had been troubled in his occupation as postman by difficulty in writing and spelling. Memory for recent events became defective. For 4 months there had been frontal headache.

Over the left posterior parietal region there was a tender œdematous prominence rising from 2 to 3 centimeters above the normal cranial outline. There was weakness, some inco-ordination and inability to detect minor differences in sensory stimuli with the right hand. There was also loss of sense of position in the right thumb and great toe. Deep reflexes were increased on the right. Plantar responses were flexor. He was mentally confused.

Operation by Mr. Sargent. First stage: A scalp flap was formed so as to expose the prominence in the left parietal region. There was what appeared to be a neoplasm about one-fourth inch in thickness between the scalp and periosteum. The skull and scalp appeared to be infiltrated. A piece of tissue was removed for histological examination and the wound closed. Second stage: Six weeks later the scalp was turned down again. It was adherent to the bone over an area 6 to 8 centimeters in diameter, both structures being infiltrated with neoplasm which was very vascular. A trephine opening was made and the involved area of bone encircled with rongeur forceps and hand saw. The bone within the circle was removed, exposing part of the longitudinal sinus. The underlying dura was adherent to a tumor beneath it which was invading the postcentral gyrus about 1 centimeter from the longitudinal fissure. This tumor was about 2 centimeters in diameter, was translucent and gelatinous. No definite limiting membrane could be made out. Most of the growth was removed. An unsuccessful attempt was made to dissect neoplastic tissue free from scalp.

After operation the patient made a good recovery except for a few days when he had hallucinations. On discharge he seemed mentally normal and the loss of sensory discrimination had practically cleared up. A letter written by him in a good hand 5 months after the operation stated that he was working for the post office, and that "I have had *no* bad headaches, eyesight good, have full use of my limbs, memory normal, and no difficulty in speaking. I might also mention that there is no disfigurement left by the operation and that my duty necessitates a 20 mile tramp over hilly country every day, Sunday included, and I am never knocked up by it." A second letter 14 months after operation reports that he is still perfectly well.

Pathology. The tissue removed during the first stage of the operation was reported by Dr. Greenfield as dural endothelioma. Sections of the bone show that it is made up of trabeculæ interlaced so as to form a bony sponge. The cavities and canals are filled with tissue, which, although poorly preserved, resembles endothelioma inasmuch as there are frequent whorls about vessels and the nuclei are close together. In the center of the bone most of the canals run parallel to the surface while nearer to the surface there is no definite pattern.

Summary. A man 45 years of age had noticed a lump on the left parietal bone for 2½ years. For 9 months there had been numbness in right hand and leg, and for 6 months difficulty with memory for recent events and with writing and spelling. He was mentally confused and had lost the power of sensory discrimination in both extremities of the right side. Operation revealed an endothelioma invading skull and scalp and, attached to the under surface of the dura, it had invaded cerebral cortex as well. Recovery was rapid and he has no abnormal symptoms 14 months after operation. Examination of the specimen removed at operation shows the bone to be porous and infiltrated with tissue resembling endothelioma, while the underlying tumor is a typical dural endothelioma.

Case 10.[1] W. E., a man of 60, was admitted to the National Hospital in 1894 under the care of Sir William Gowers. He was comatose on admission. His wife stated that he had had a lump on his skull for 10 years, that he had become strange mentally and developed a left hemiplegia 6 weeks before admission. He died in the hospital and at postmortem examination, there was described a "bossy projection" on the vertex of the skull just to the left of the midline. "On removing the skull cap, the prominence was found to correspond to a tumor which was situated in the dura mater and projected upward and also pressed on the ascending parietal convolution causing a depression." There was also a tumor in the centrum ovale of the right hemisphere. The report does not make it clear whether or not this tumor was co-extensive with that attached to the dura. The following note is added: "A small scraping of the tumour shewed it to consist mainly of small, round cells with a few branched cells like those of a myxoma." It is not clear from which tumor these scrapings were obtained.

Summary. A man of 60 admitted in coma with a history of 10 years' growth of a hard swelling over the vertex of the skull. For 6 weeks he had been

[1] This case is the only one in the series without endothelial tissue, but as there was a dural neoplasm under which lay a dural neoplasm, it is included in the series.

hemiplegic. At autopsy, a neoplasm of the dura was found beneath the prominence and another, possibly separate, tumor in the centrum ovale of the other side.

REVIEW OF LITERATURE[1]

In 1883, Drummond (8) cited a case of tumor of the skull, reported by Louis, which was of 9 years' duration and which Louis considered to be a special form of tumor of the dura.

Brissaud and Leréboullet (4) in 1903 described, under the title of hemicraniosis, two cases presenting a bony prominence of one side of the skull. In only one was there a microscopical examination. This was a woman of 31 who had a large hard prominence over the right frontal bone. For 2½ years she had complained of headache, vomiting, and intermittent strabismus. She showed marked exophthalmos and bilateral papillœdema. She died in hospital and at autopsy the right frontal bone was found very much thickened, including the supra-orbital ridge. The under surface of this thickened bone was adherent to dura, which in turn was studded on *its* under surface with small and large circumscribed tumors which displaced the frontal lobe. The bases of the tumors where they were sewed over the dura, were calcified and gave the appearance, according to the authors, of angiolithic sarcoma. The bone was not decalcified and examined.

The cranial enlargement was one-sided in this case, and likewise in the other case in which no pathological examination had been made. The authors, therefore, considered the condition to be the converse of facial hemiatrophy, except that the hypertrophy seemed to be limited to the ophthalmic division of the fifth cranial nerve. They call attention to the curious rôle the dura seems to play: that of developing exostoses on one side and multiple tumors on the other. The picture of the patient shows a large, smooth prominence on the frontal bone which only differs from the picture of J. B. (Fig. 15), in that the prominence is a little more one-sided. The tumors growing from the dura without infiltrating brain may be fairly considered to belong to the type called by many psammoma or endothelioma.

In 1904 Parhon and Goldstein (14) reported a second case of hemicraniosis with histological examination. A woman who had died of pneumonia was found to have a lump on one parietal bone. The underlying dura was adherent to the bone and attached to a large circumscribed tumor which had displaced brain. The bone was said to be eburnated and the underlying tumor an angiolithic sarcoma or psammoma.

In 1905 Parhon and Nadjede (15) reported another case, a woman of 63 who at autopsy showed a smooth excrescence on the right frontal bone. The under surface of the bone was irregular and beneath it, attached to the dura, was a large, red-grey, angiolithic sarcoma or psammoma which did not infiltrate brain tissue. It was noted that in this and the preceding case, although there was no supra-orbital thickening, the process was otherwise the same as that described by Brissaud and Leréboullet.

In 1907 Spiller (17) reviewed the other three cases of hemicraniosis described above and added two more, brief descriptions of which follow.

Case 1. The patient received a blow on the head 16 years before admission. He had noticed the beginning of enlargement of the left parietal region 8 years before, for 3 years paræsthesia in the right side, and for a few months convulsions, nausea, and vomiting. The patient died from hæmorrhage following attempted operative removal of the bony tumor which was adherent to the dura. The pathological examination by Dr. Kirkbride showed that the tissues of the scalp which had lain over the tumor were much indurated, there being marked increase in the fibrous tissue between the bundles of which were occasional, small spicules of bone. On the outer surface were nodular exostoses and shreds of adherent pericranium. The inner surface of the bone was convex and honeycombed, with dura adherent to it. Beneath the thickened skull, a large gray encapsulated tumor was found attached to dura and falx.

The tumor was an endothelioma and, from the careful microscopic description, it is apparent that the skull and probably the scalp were infiltrated with neoplasm as well.

Case 2. The patient complained of right-sided paresis and some aphasia. A hard swelling had been noticed for 6 or 7 months in the left parietal region of the skull. At operation, Frazier removed the tumor of the skull. It was examined microscopically and reported to be free from tumor cells. At the second stage of the operation, the same operator shelled out from beneath the exposed dura an endothelioma.

It would seem that both of these cases resemble the series of cases reported in this paper. In the first case the bone and probably the scalp were infiltrated with growth, to judge from the microscopic examination. The negative report of the microscopic examination of the bone in the second case comes as a surprise in the face of the fact that the bony prominence had been noted only 7 months before admission and was, therefore, probably increasing in size.

One more case was quoted by Spiller. In 1906, Barling and Leith (3) reported the case of a man of 30 who for a year had had attacks of Jacksonian epilepsy together with right-sided paresis and headaches. A trephine button of bone was removed by another operator and the operation was abandoned because of hæmorrhage. Six months later the patient was operated upon by Mr. Barling. The wound

[1] This paper as published was entered in the competition for the Warren Triennial Prize at the Massachusetts General Hospital in April, 1922. This explains the fact that no reference is made to an article published by Dr. Harvey Cushing in the August number of *Archives of Neu-*[illegible] Meningeal Endotheliomata." In this article the type of neoplasm under consideration is described and a splendid example given. Cushing states that 25 per cent of the endotheliomata in his series are associated with overlying "hyperostosis cranii" although he does not state in this preliminary communication in how many of this group the bone was studied microscopically. His view is much the same as that set forth in this paper; that the process is one of "invasion of the bony canals by tumor cells, with resultant stimulation of osteoblasts and the production of new bone."

showed no implantation of tumor in it, nor any fungating mass. The bone which was adherent to dura was removed, and at a second stage an underlying endothelioma was lifted out. Professor Leith, in a very careful report, stated that the bone over the growth was slightly thickened, more spongy and more vascular than normal. Tumor cells penetrated the diploe, a few reaching the outer table. The "increased porosity," he stated, was apparently brought about by small irregular cells lining the spaces. No large osteoclasts were seen. He argued for extension into the bone by continuity through numerous small openings in the dura. In this case no lump was noted before operation, and this may be taken, perhaps, as a very early stage in the bone invasion before much new bone had been laid down.

To the six cases collected by Spiller, which include two of his own, may be added five others.

In 1904, Bruns (5) cited a case, reported by Roemer, of endothelioma a part of which lay between skin and skull and part in the diploe. The tumor projected into one frontal lobe.

Ballance (2), in 1907, described a patient who presented a hard smooth swelling in the right frontal region, which had been noted first 7 years previously. He had been subject to epileptic seizures dating from the same time and headaches for 18 months. Operative removal of the bony prominence was followed quickly by death. At postmortem, a cerebral tumor was found beneath the cranial defect. After examination, it was suggested that this tumor had commenced as a "hæmangio-endothelioma and developed into a more common form of sarcoma." The overlying bone was 1¼ inches thick at its center and presented a "coral-like appearance due to infiltration with new-growth."

Krause (10) describes in his *Surgery of the Brain*, 1912, an operation performed by him in 1904 on a man of 41 years, who had noticed a lump on his right forehead for 5 years. During that time he had had severe headaches and for 2 years epileptic convulsions. For a short time he had shown mental symptoms. The tumor of the skull, which was about the size of a goose egg, was removed and, because of hæmorrhage, operation was discontinued. Death from pneumonia followed. When the dura was lifted from the brain at postmortem examination, an encapsulated, bluish tumor the size of a billiard ball was lifted out by its attachment to the dura. This intracranial tumor had penetrated the outer layer of dura beneath the bony prominence, but, unfortunately, there is no microscopical report of either tumor. Krause observed that this was a rare instance of an encapsulated brain tumor, giving evidence of its presence externally.

In 1917, Tattersall (18) reported the case of a patient, who died in an Insane Asylum, with a hard swelling in the right temporal fossa. There had been 10 years of headache and vomiting. Mentally the patient was childish and memory was defective. The bone was reported as resembling a flattened, fusiform, osseous plaque consisting of cancellous growth of bone from both surfaces. It was not adherent to the dura but externally the scalp was infiltrated. Beneath the dura and adherent to it was an "extremely necrotic growth" occupying the whole width of the hemisphere. Microscopically, it was an endothelioma. Sections of the bone showed that *it* contained the same neoplasm.

Ashurst (1), in 1920, reported the case of a patient who had noticed a hard lump slowly growing in the right parietal region. For a year he had had occasional epileptic convulsions, and for 3 weeks headache and vomiting. The bony tumor was removed at operation and its under surface found to be eroded, the outer surface being adherent to the aponeurosis. A circumscribed intracranial tumor attached to the underlying dura was removed as well, and the patient made an excellent recovery. The tumor itself was examined microscopically by Spiller, who classed it as an endothelioma and was quoted as saying: "He was further of the opinion that such growths in the brain were frequently the result of irritation from a lesion of the skull originally traumatic in origin. This had been Dr. Ashurst's belief at the time of operation."

In a personal communication, Dr. Spiller adds another case from his wide clinical experience. He had a patient who came to him with enlargement of a limited portion of the skull and some intracranial symptoms. He made a diagnosis of endothelioma and advised operation, which was refused. Several years later the patient died, and an endothelioma was found where it had been suspected.

The cases collected above show striking similarity clinically and histologically. Of the 11 cases described only two gave a definite history of trauma, one of them 4 years before the onset of symptoms, and the other 8 years before that time. In 9 of the cases the patient had noticed a lump on the skull on an average of 4.3 years before admission. No history is recorded in the case of two patients. The first symptom was epileptoid seizures in four cases, headaches in three, and hemiplegia in two.

The tumor itself was declared to be an endothelioma or angiolithic sarcoma in all but one case, and in this case there was no microscopic report. It was adherent to the dura in every case in which there was a careful description. The bone was specifically described as infiltrated with neoplasm in four cases. In only three cases were microscopic sections of the bone reported. In two of these tumor cells were found to fill the bone canals. In the third, the bone was reported as free from growth. Seven of the reported cases were operated upon. Of these, four died as the immediate result of the operation and three survived and showed satisfactory improvement.

GENERAL DISCUSSION

In addition to the above cases collected from the literature, tumors of the type described in this paper must have been encoun-

tered by many brain surgeons and neurologists.[1] The nature of the osseous part of the tumor and the fact that one has to deal here with a well-defined group of cases has been overlooked. Bruns (5), describing the sarcomata which arise in the neighborhood of dura mater and grow both ways, perforating the skull, says that he has been of the opinion that these tumors are derived from dura and bone and are not sarcoma but endothelioma. An accompanying diagram, however, shows a tumor *perforating* the skull, not infiltrating it. Oppenheim (13), in a monograph on tumors of the brain, mentions sarcomata which may grow from skull, dura, or brain, and at times perforate the skull.

Sarcomata, perforating the skull, have been frequently described and seem to be more clearly recognized than endotheliomata which infiltrate, and cause bony lumps on, the skull. To judge from the reports of the 420 cases of brain tumor examined for this study, the latter group is very much more common. (The term sarcoma was used formerly by many authors to mean what is now called endothelioma.) The cases were, of course, in a certain sense selected inasmuch as they had all been referred to a hospital for diseases of the nervous system.

Foster Kennedy (9), referring to whorl-celled endotheliomata says, "not infrequently these neoplasms arising from the falx or other portion of the dura mater produce by irritation of the periosteum of the skull, such localized thickening of the bone as to give rise to bony knobs on the cranium, which invite by their appearance the diagnosis of primary osteomata of the skull." Krause (10) takes a somewhat similar view of these dural endotheliomata, observing that, since the dura performs the function of the inner periosteum, it is not surprising that, as a result of irritation, the bone is induced to grow and is found heaped up in such cases, as much as 21 millimeters over the growth.

Even though one supposes that the endothelioma is primary and the bony excrescence secondary to it, it is difficult to conceive why direct irritation of the dura or internal periosteum should cause an external tumor of bone. In many cases there is little or no elevation on the internal surface of the skull and frequently there is erosion of the under surface of the bone.

On the other hand, a different explanation has been offered by Parhon and Nadjede (15). They recall the fact that Babès, in discussing such a tumor with an overlying osseous prominence, suggested that the old bony lump had caused the intracranial tumor by irritation; but he stated that it was the first time he had seen a tumor of one nature give rise to another entirely different in character. The authors then suggested the theory that there is some irritative process in the dura, causing it to lay down tumor on one side and bone on the other. They profess ignorance of the pathogenic agent which causes such dural activity, and suggest experimental extradural injections of irritative fluid in an attempt to reproduce the condition.

Spiller's explanation, somewhat similar to that of Babès, is that the lesion of the skull in the nature of a "local thickening" appears first, probably, as the result of trauma. Secondarily, "pressure from the thickened bone . . . on the dura is liable to cause the formation of endothelioma growing from dura" (17).

In regard to the part played by trauma, it may be noted that in only 2 of the 10 cases reported in this paper was there record of any cranial injury, and in one of these cases the injury preceded the appearance of the tumor of the skull by 7 years. Nevertheless it cannot be denied that trauma may be a factor.

Operations on these cases offer a real hope of permanent cure. Of the 11 cases reported in medical literature, 6 of them had been operated upon. Two of the patients, who had cranial bosses of 7 and 8 years' duration respectively, died from operative hæmorrhage, and one from pneumonia several days after operation. The remaining 3 cases made a good recovery from operation and were discharged cured or improved. There is no record of what finally happened to them, except that one died during a plastic operation 6 months after the removal.

Of the 11 cases reported in this communication, 9 were operated upon either by Sir

Victor Horsley or Mr. Sargent. Two died within 36 hours after the operation. One died 12 days after, cause of death not stated, and the fourth died 7 weeks after operation as a result of sepsis. The other 5 were discharged quite cured, except that one patient had a limp from a hemiplegia which developed as a sequel to operation. Three of these patients are living today, 16 years, 12 years, and 14 months after operation, respectively. They have had no recurrence and are perfectly well, so far as their original malady is concerned, except that one suffers from headaches as a result of an unusually large cranial defect. No trace can be found of the remaining 2 cases which survived operation.

These neoplasms are invariably extremely vascular, and removal of the cranial portion without opening the dura may result in hæmorrhage, and perhaps operative shock, sufficient to cause death. After the scalp flap is turned down, it seems to be best to encircle the bony prominence by cuts through the normal skull. The bone can then be broken away, leaving the adherent dura behind. The operation may be stopped at this point, and the dura and underlying tumor removed at a second stage operation, or the whole procedure completed at once, depending on the patient's condition.

Operation should, of course, be as early as possible, inasmuch as this is a type of brain tumor which holds out promise of a brilliant result to the successful operator. To this end, it is of importance that the early signs and symptoms should be commonly recognized.

In this series of 10 cases, all of the patients had noticed an increasing lump on the cranial vault, before admission. In 4 cases it had been the first evidence of anything wrong, and in 2 cases the enlargement was not noticed until the onset of the first symptom. In 7 of the 10 cases, the first symptom complained of was pain, usually most intense beneath the cranial boss. In 2 cases the first symptom was an epileptoid seizure and in the remaining case, there is no mention of the early symptoms. There was a time, then, in 70 per cent (possibly 80 per cent) of the cases when the patient had only the typical bony swelling and pain beneath it, usually of a stabbing character. This is the time when the diagnosis should be made and the operation performed. In one instance the patient, a nurse, sought advice because of curiosity over a slowly growing cranial lump. Her only complaint was "neuralgic headaches," not localized. Thanks to their great experience, Gowers and Horsley recognized the nature of the condition thus early, and the tumor was successfully removed.

The symptoms which follow pain are due to encroachment on the cerebrum. Epileptoid seizures are common. There may be hemiplegia or symptoms of increased intracranial pressure, depending, of course, on the location and size of the tumor. The most frequent location is frontal, but the temporal or parietal bone is often the site of the neoplasm. Not infrequently, one or both orbits are involved and the falx is at times infiltrated. There is no record of such a tumor in the occipital or suboccipital regions.

There is a considerable variation in the age incidence. The youngest in the series was 18 and the oldest 60 years. The average age was 39. Of the 17 cases including 7 from the literature, five were women and twelve were men.

HISTOLOGY

Endothelioma of the dura is a term that one would like to drop altogether if it were not for the sanction of common usage. As a matter of fact there is no proof that these tumors develop from the endothelium of blood vessels and, although the term has been used in this paper, it is recognized that the name is *not* a good one.

Endotheliomata and psammomata are generally understood to be circumscribed tumors which grow very slowly, do not metastasize, and are benign in the sense that they are usually covered by a limiting membrane. Histologically, they present characteristic whorls and occasionally a "palisade" arrangement of cells. This type of tumor has been said to arise from the inner layer of the dura (Monckeberg, 12). It rarely penetrates the outer layers of the dura (Krause, 10, vol. i, p. 72), usually growing inward and pushing brain before it.

In 1903, Schmidt (16) proposed that the so-called sarcomata and psammomata of the

dura arise in reality, not from the dura mater, but from the arachnoid. He described the manner in which pacchionian granulations begin, i.e., as tufts of arachnoid capped with cones of solid cells, which penetrate the dura, usually following vessels, and pierce its outer layer. His reasons for urging the development of these tumors from the pacchionian granulations include the similarity of histological pictures, the tendency to similar location, and the continuity of structure demonstrated in several cases between tumor and pacchionian body.

Mallory (11, 1920), in a careful histological study of dural endotheliomata, reached a conclusion similar to that of Schmidt. He states that there is no dural endothelium and that the internal aspect of dura is bare except for fibroblasts. These tumors which he would call arachnoid fibroblastomata arise, he maintains, in the arachnoid and receive their blood vessels and connective tissue from the dura.

Cushing and Weed (6), in 1915, suggested the same derivation, and Weed (19), in an anatomical study, described cell clusters in the arachnoid membrane. The clusters increase with age and usually become adherent to the dura. In two cats he found small neoplasms on the arachnoid. The smaller of the two was slightly adherent to the dura but a line of cleavage remained. The larger one was intimately adherent, although not infiltrating the dura. He calls attention to the fact that these cell clusters present the same histological picture as endothelioma and frequently show typical calcareous granules or corpora amylacea.

The peculiarity of the series of endotheliomata reported here is not only that they have infiltrated the overlying skull and sometimes scalp, but that they have caused to be laid down more bone externally on the skull. It seems most unusual that in one part of a neoplasm osteogenesis should occur, while in the other part there is none. Calcification of endotheliomata which are wholly within the cranial cavity, *without bone formation*, is frequent, but the calcium is confined to small deposits called corpora amylacea. Plaques of true bone laid down on the arachnoid membrane have been not infrequently reported, especially in the spinal part of this membrane. (For references see Cushing and Weed, 6.)

To judge from the microscopic appearance of this type of neoplasm in different stages, its growth appears to be as follows:

Derived from inner layers of dura or, more probably from the arachnoid, it is firmly attached to the under surface of the dura. Columns of endothelioma cells are found in the dura, passing through it along the course of blood vessels (Fig. 8). The connective-tissue septa in the layer of tumor between bone and dura are continuous with the tissue of the dura itself (Fig. 4). The neoplasm invades the overlying skull. This is associated with absorption of bone and laying down of new bone. In early cases, that is of a year or two standing, the bone tends to be more porous. In long-standing cases, the bone is usually more eburnated. The whole bone pattern becomes altered, the external table is absorbed and remade so that the outer surface of skull as a rule slopes gradually up on the neoplastic prominence. Endothelioma cells are everywhere filling all the haversian canals and spaces. But there lie between these cells and the bone, cells resembling connective tissue. At the apex of the tumor, beneath the scalp, there is invariably a pad of endothelioma. Here the bone proliferation is most active and here the connective-tissue cells just mentioned are most in evidence, surrounding the newly formed bone spicules (Figs. 4, 23, 24). These spicules may be laid down perpendicularly to the skull (Fig. 11). In some of the cases the endothelioma infiltrates the overlying scalp or temporal muscle and scalp. There may appear small excrescences of bone on the under surface of the skull. The intracranial part of the tumor is not ossified, also grows very slowly, and does not infiltrate brain. In some cases of long standing this intracranial portion is small. In some cases it is found spread out thin over the brain (Fig. 17), in others it is attached to the dura over a small area but enlarged beneath so as to displace large areas of brain (Fig. 7).

The nature of the cells which form a thin strip of many layers covering over the newly forming areas of bone is of considerable interest. The nuclei are elongated at the outside

becoming oval and shorter as the bone is approached. The nuclei are less closely packed than those of the endothelioma so that the tissue appears to stain less deeply. It is evident that these cells have to do with bone formation and they resemble the osteoblasts seen in ordinary bone repair. There are connective-tissue septa running through the tumor which are seen to be continuous in places with the bone-forming cells.

Whence are these cells derived? The connective tissue of dura or bone may have proliferated and grown along with the tumor to assume the function of osteogenesis in this slowly growing neoplasm. On the other hand, one may assume that the cells of the endothelioma have acted as osteoblasts, changing somewhat in appearance during bone formation. As was mentioned above, the arachnoid has been observed to contain bone, and the dura is said to serve as periosteum to the skull. But if the bone is formed by cells derived from the tumor, it is difficult to understand why the intracranial portion of the endothelioma, which is likewise slow in growth, should not form bone also. It seems, therefore, more reasonable to suppose that the osteogenetic cells, which resemble the fibroblasts derived from periosteum and bone tissue during ordinary bone regeneration, are derived either from the outer layers of the dura or from the bone itself.

The manner of growth of these neoplasms is unique. They rarely, if ever, penetrate the pia, but they pass through dura mater and skull and may enter scalp. During the passage through the bone they do not crowd out and destroy all that lies in their path. There is, of course, rarefication of the bone originally overlying the tumor, but the bone-forming cells which are encountered are stimulated to proliferate and to lay down new bone. It is probable that all bone is in a state of flux, the haversian system pattern being constantly altered by absorption and redeposition. This is especially true when the bone is subjected to unusual conditions such as obtain in a fracture. Thus in a certain sense, the neoplasm may be said to respect the function of the tissue invaded. This is true to such an extent that the tumor itself becomes in a large part replaced by bone, a fact that explains why, in reports of these cases, it has usually been taken for granted that the bony prominence was a simple exostosis.

SUMMARY

There is a group of dural endotheliomata which give evidence of their presence and position by a typical, slowly growing, hard prominence on the cranium. The nature of these neoplasms has not been generally understood. They have been called hemicranioses by some authors, in the belief that they were hypertrophies invariably situated in the cutaneous distribution of the first division of the trigeminal nerve. The cranial boss has been frequently considered to be a simple exostosis.

The microscopic picture of these tumors is that of the so-called endothelioma of the dura, their nuclei being frequently arranged in whorls or palisades. They appear to arise from the arachnoidea or inner layer of the dura mater, displacing without infiltrating brain. They pass through the dura in a number of places, enter the overlying bone, and cause a complete rearrangement of the osseous structure. The bone-forming elements are caused to lay down bone in the substance of the neoplasm. This osteogenetic activity is greatest in a pad of endothelioma that comes to lie between skull and scalp, with the result that an osseous tumor forms on the external surface of the cranium and may become very large and hard. The temporal muscle and scalp may be infiltrated with the neoplasm.

Four hundred and twenty histories of cases, in which the diagnosis of brain tumor had been proven at operation or autopsy, were studied and, of these tumors, 11 were found to be associated with a lump on the cranial vault. In one of these 11 cases the lump was soft and could be pressed inward through the skull. This proved to be a sarcoma and could not have been confused clinically with the remaining 10 cases, in all of which the lump was quite evidently a bony prominence of the skull. All of these 10 cases presented the same pathological picture and similar clinical histories.

Operative removal, in cases where the patient survived the immediate effects, has resulted in cures. In most instances, it should be possible to make the diagnosis before the

onset of distressing cerebral symptoms. The characteristic cranial prominence increasing over a considerable period, associated with pain of a stabbing character beneath the tumor, is pathognomonic of the condition.

Whatever may be the etiology of these tumors, the cranial prominence is secondary to invasion of the skull by the intracranial tumor. It is incorrect to suppose that the cranial and intracranial tumors are of entirely different nature. They are the same except that the growth of the former is accompanied by bone formation. It is evident, therefore, that the following hypotheses are incorrect: (1) that a primary thickening of the skull irritates the dura and thus causes the appearance of an intracranial endothelioma, or (2) that some irritation causes the dura to lay down neoplasm on one side and exostosis on the other. It is usually impossible to elicit a history of trauma, and yet the much greater incidence of this type of endothelioma among men than women suggests that trauma may be in some way an etiological factor.

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RENAL FUNCTION FOLLOWING NEPHROTOMY[1]

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BECAUSE of the danger of hæmorrhage and the probable great injury to kidney function following nephrolithotomy, the operation of pelviolithotomy has become the operation of choice, at least in this country, in the treatment of renal calculi. Marion considers nephrotomy indicated when it is impossible to extract calculi by pyelotomy. Lower says that stones which cannot be removed through the pelvis of the kidney must be reached by one or more incisions into the kidney. He advises against bisection of the kidney and considers it best to cut directly over the stone. Binnie quotes Rovsing as saying that the injury to parenchyma following nephrolithotomy is of comparatively little importance. Cathelin asserts that nephrolithotomy is the type of operation which rules for renal calculi. Rehn says that in 10 to 12 per cent of cases of nephrotomy, there are dangerous secondary hæmorrhages or urinary fistulæ. He belives that nephrotomy in itself affects kidney function seriously, and, as a method of averting hæmorrhage, advocates fixation of the kidney and careful drainage of the renal pelvis, in some cases by a ureteral catheter extending from the pelvis of the kidney into the bladder. W. J. Mayo says, "pelviolithotomy is the most generally useful operation for stone in the kidney." Deaver formerly removed nearly all renal calculi by nephrotomy, but he has discarded the procedure in favor of pelviolithotomy because of the danger of hæmorrhage after nephrolithotomy. Marwedel's method of performing nephrotomy, consisting of a transverse incision through the parenchyma of the kidney into the pelvis, has not been considered.

From a review of twenty-one complete nephrotomies performed between 1910 and 1921 at the Mayo Clinic, for various conditions, it was found necessary in four instances (19.5 per cent) to perform a secondary nephrectomy for hæmorrhage within a period of 4 weeks after the primary operation. Nephrotomy was performed for unilateral hæmaturia in 16 cases. The line of incision into the kidney was in the anatomical middle line of the cortex of the kidney in 6, and just posterior to the middle line in 4. The methods of suture used to close the kidney and the type and amount of drainage varied.

The nephrolithotomy was bilateral in 2 of 150 cases observed in the Mayo Clinic. In 1 of these the patient was well 8 years later; the other patient had a recurrence of stone. Unilateral nephrolithotomy was followed or preceded by a nephrectomy of the other kidney in 6 cases. Five of the patients were alive and well 5 years after operation; the other was well for 3 years and then died. It was necessary to perform a nephrectomy because of hæmorrhage in 2 of the 150 cases. In 3 it was necessary to remove the kidney which had been subjected to nephrolithotomy because of infection in the kidney. This infection was, of course, present to a degree before the nephrolithotomy was performed.

CASES ILLUSTRATING THE AMOUNT OF FUNCTION PRESENT AFTER INCISION OF THE KIDNEY

Case 1. (A108397.) A left nephrolithotomy was performed June 30, 1914, with removal of two stones; one in the upper pole was branched. The wound was closed without drainage. August 26, 1914, the right kidney was removed for pyonephrosis. At this time the phenolsulphonephthalein test revealed 60 per cent secretion in 2 hours. In 1915 the patient had an acute perforation of a duodenal ulcer, resulting in a duodenal fistula which was repaired. In 1917 the phenolsulphonephthalein excretion was still normal, and in 1921 the patient wrote that he was "feeling fine," with no untoward symptoms.

Case 2. (A581175.) A left nephrolithotomy and pelviolithotomy were performed in 1911; 11 days after operation it was necessary to remove the left kidney because of uncontrollable secondary hæmorrhage. In 1913 a large branched stone was removed from the right kidney by nephrotomy. The phenolsulphonephthalein excretion in 1915 was 47 per cent in 2 hours, and in 1919, 50 per cent. The patient was in excellent condition in 1921.

[1]From the Division of Experimental Surgery and Pathology and the Section on Urology.

Fig. 1.

Fig. 1 (at left). Roentgenogram of human kidney with arteries injected with barium sulphate solution.

Fig. 2.

Fig. 2. Roentgenogram of dog's kidney with arteries injected with barium sulphate solution.

Case 3. (A58173.) A right nephrolithotomy was performed in 1911. October, 1916, the pelvis of the left kidney was opened, but no stone found. A month later a left nephrolithotomy was performed and a stone removed from the inferior calyx. The renal wound was closed with one tube drainage. In 1920, the left kidney was again incised in two places and two stones were removed. The kidney appeared to be inflamed. The phenolsulphonephthalein excretion in 1922 was 40 per cent in 2 hours, and the blood urea was 36 milligrams for each 100 cubic centimeters of blood. At this time there was a recurrence of stones in both kidneys with a 15 per cent return of phenolsulphonephthalein from the left kidney in 15 minutes and 4 per cent in the right kidney. The function of the right kidney seemed to be greatly reduced.

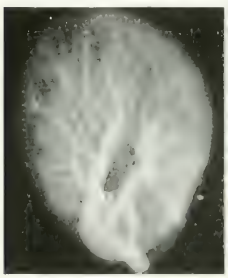

Fig. 3.

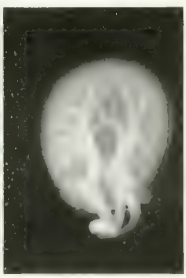

Fig. 4.

Fig. 3 (at left). Roentgenogram of human kidney with arteries injected with barium sulphate solution. View from the pole.

Fig. 4. Roentgenogram of dog's kidney with arteries injected with barium sulphate solution. View from the pole.

Case 4. (A169613.) In 1916, one large branched stone and a smaller stone were removed from the upper pole of the right kidney by nephrolithotomy. The function before operation, as estimated by the excretion of phenolsulphonephthalein, was 15 per cent in 15 minutes, from the right kidney, and 14 per cent in 15 minutes from the left kidney. July 21, 1917, 1 year after operation, the excretion was 12 per cent in 15 minutes from the right kidney, and 22 per cent in 15 minutes from the bladder.

Case 5. (A338142.) A right nephrolithotomy was performed November 27, 1920. The kidney was split from pole to pole. The renal wound was drained with two tubes. May 20, 1922, the left kidney was removed for extensive infection. October 31, 1920, the phenolsulphonephthalein excretion before nephrolithotomy was 10 per cent in 15 minutes from the right kidney. As the elimination of phenolsulphonephthalein was 25 per cent in 1922, and the left kidney was functionless, there must have been considerable increase in function of the right kidney following nephrotomy

EXPERIMENTAL WORK

In a masterly work Tuffier demonstrated that 1.5 grams of secreting kidney parenchyma for each kilogram of animal weight was compatible with the life of the animal. Thus he was among the first to believe and to show that life may exist with considerable loss of the substance of kidney. By conducting a series of experiments he found that the best way to incise the kidney and to suture the renal wound is to cut through the convex border of the kidney leading into the pelvis, and to close with four to six deep sutures through the medulla, tying them over the cortex. Between

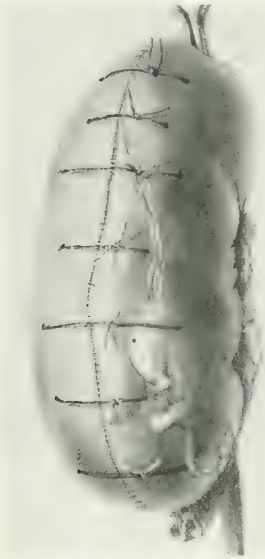

Fig. 5.

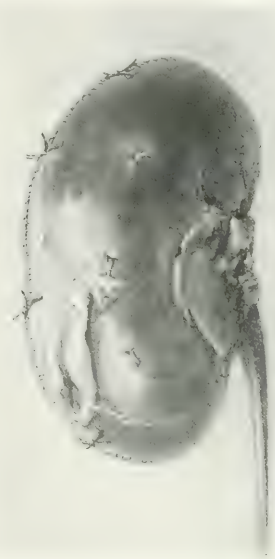

Fig. 6.

Fig. 5 (at left). Suture of nephrotomy wound by deep sutures tied over the cortex.
Fig. 6. Suture of nephrotomy wound by three mattress sutures and continuous suture of fibrous capsule.

these, superficial sutures are placed and tied in the same manner. Tuffier concluded, from a microscopical study of the nephrotomy wounds, that it is possible to suture the wound and obtain union by first intention without injuring the structure or function of the remainder of the gland.

Cullen and Derge quote Broedel as saying: "In man and the dog there are as a rule two main arterial trunks supplying the kidney, one passing to the anterior and the other to the posterior portion." Cullen and Derge conducted a series of experiments in which they performed nephrotomy in the avascular line as advised by Broedel, using both the knife and silver wire for incising, and cutting from without in and from within out. They studied the amount of blood lost in these various procedures and the character of the scars produced. The wounds were closed with a single row of mattress sutures of fine black silk. The authors conclude that the value of the silver wire lies more in the rapidity with which hæmorrhage stops and the ease with which it may be controlled than in the actual amount of blood lost in a given time; also that the wounds produced by the wire cutting from within out heal more readily and with less destruction of tissue than those produced with the knife.

Moore and Corbett say that nephrotomy always results in some destruction of kidney substance. They performed a series of experiments on rabbits in which they incised the kidney from pole to pole in the median line, extending through the kidney substance. The wounds were sutured by (1) continuous suture of the capsule only, (2) continuous mattress suture parallel to the wound, and (3) interrupted sutures traversing the kidney and tied over the cortex. Three sutures were generally used. The animals were killed at the

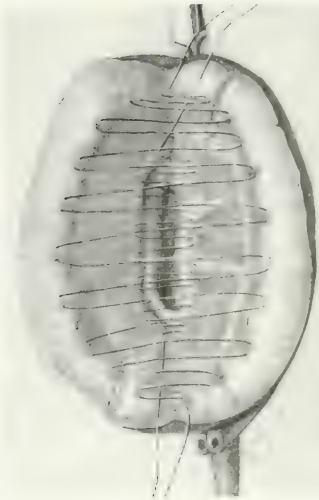

Fig. 7.

Fig. 7. Suture of nephrotomy wound with two layers of running mattress sutures.

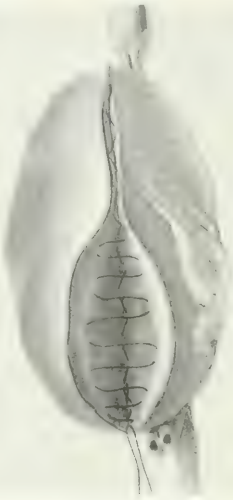

Fig. 8.

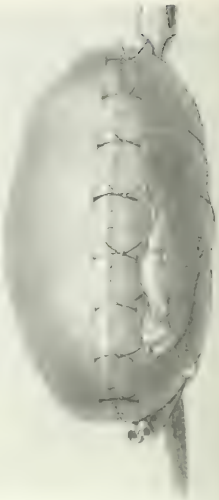

Fig. 9.

Fig. 8. Same as Figure 7, with lower suture drawn taut.
Fig. 9. Same as Figure 8, wound closed.

end of 10, 37, and 90 days, and the wounds carefully studied.

Moore and Corbett conclude that (1) an operation on the kidney always destroys a certain amount of kidney substance; (2) the section of the kidney does less harm than the

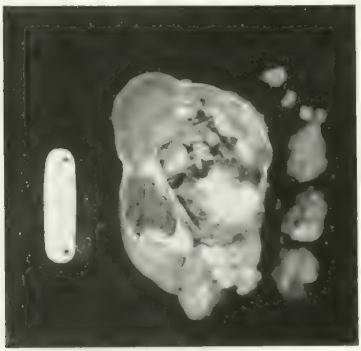

Fig. 10. Cross section of kidney adjacent to nephrotomy, showing injected vessels intact and clean formation.

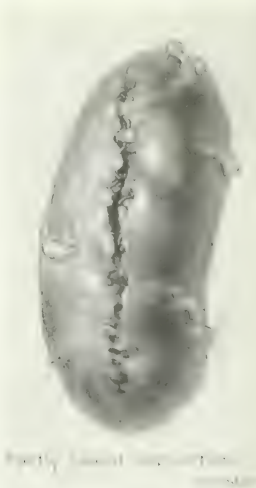

Fig. 10. Partly [illegible] operation.

Fig. 12. Cross section of nephrotomy incision, 7 days after operation.

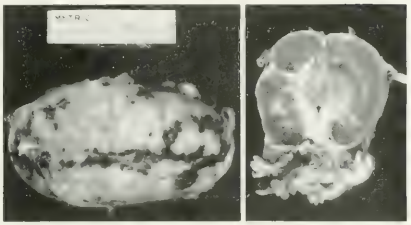

Fig. 13. Fig. 14

Fig. 13 (at left). Kidney, 3 months after nephrotomy.
Fig. 14. Cross section of kidney shown in Figure 13.

suture necessary to control hæmorrhage; (3) suture of the capsule alone is not sufficient to control hæmorrhage; (4) mattress sutures

TABLE I.—SERIES I, II AND IV

Dog No.	Normal weight, kg.	Normal condition of animal	Type of suture for nephrotomy	Length of life, months	Complications	Weight at end of experiment, kg.	Condition of animal at end of experiment	Remarks
				SERIES I				
132	9.7	Good	Double mattress	4	None	11.3	Good	Left kidney weighs 30.5 gm., nodular. Depression at line of incision, destruction of tissue around scar, kidney cells in fair condition. Right kidney weighs 30 gm. Depression at line of incision. Kidney cells in good condition.
135	15.3	Good	Deep sutures tied over cortex	1	Uræmia	9.5	Fair	Left kidney weighs 17.5 gm., contracted, marked degeneration of kidney tissue. Right kidney weighs 18 gm., contracted, marked degeneration.
559	9.9	Good	Double mattress	0.1	Hæmorrhage		Poor	Left kidney weighs 90 gm., practically destroyed from hæmorrhage. Right kidney weighs 20 gm., blood clot in line of incision. Kidney cells in poor condition.
				SERIES II				
104	8.7	Good	Double mattress	9 (still alive)	Gave birth to three puppies	8.9	Excellent	None
120	8.9	Good	Double mattress	10 (still alive)	None	10.2	Excellent	None
				SERIES IV				
529	12.8	Fair	Mattress	1 (still alive)	None	10.0	Good	None
525	15.3	Good	Double mattress	4	None	13.7	Good	None
591	10.9	Fair	Double mattress	1	Death, 7-21-22	Last weight 7-20-22 9.1	Poor	Right kidney weighs 40 gm., deeply scarred with acute pyelonephritis. Much destruction of kidney substance, replacement with connective tissue and round cells. Kidney cells generally in poor condition. Left kidney weighs 33.5 gm.
544	17.8	Good	Double mattress	1	Death, 9-18-22	Last weight 7-18-22 16.2	Good	Incision healed nicely; microscopically the kidney was generally in good condition.

TABLE II.—SERIES III

Dog No.	Normal weight kg.	Normal condition of animal	Type of suture for nephrotomy	Length of time, months	Complications	Weight at end of experiment, kg.	Condition of animal at end of experiment	Remarks
				SERIES III				
219	13.2	Good	Deep sutures tied over cortex	4	Stone formation, uræmia	13.7	Good	Left kidney weighs 71 gm., contains multiple stones, posterior portion atrophic, general poor condition of kidney substance
132	7.1	Good	Double mattress	8	None	7.6	Excellent	None
0.5	8.6	Fair	Mattress	3	Uræmia	6.9	Fair	Left kidney weighs 25 gm., generally in poor condition. Right kidney weighs 27.5 gm. in poor condition after nephrectomy.
232	9.2	Fair	Deep sutures tied over cortex	10	Gave birth to three puppies	8.4	Good	Left kidney weighs 26.5 gm., fairly good condition. In general the kidney substance seems to be in rather poor condition. Right kidney weighs 26.4 gm.
0.7	7.2	Fair	Mattress	0.83	Uræmia		Poor	Left kidney: blood clot in line of incision, areas of necrosis, marked degeneration of kidney substance.
218	9.7	Good	Double mattress	2.5	Uræmia, hæmorrhage		Poor	Left kidney weighs 37 gm., line of incision in medulla necrotic. Kidney substance shows marked degeneration.
140		Poor	Double mattress	0.2	None		Fair	Right kidney weighs 24 gm., incision healing nicely. Kidney cells in good condition.
191	14.3	Good	Double mattress	4	Stone formation	11.3	Good	Kidney contained stones, no further pathological condition ascertained. Cause of death unknown.
228	10.1	Fair	Double mattress	2.1	Uræmia, primary hæmorrhage		Poor	Left kidney weighs 81.2 gm., hæmorrhage from cortex, with separation of incision. General degeneration of kidney substance.
129	14.2	Good	Deep sutures tied over cortex	0.37	Uræmia		Very poor	Right kidney, general poor condition, areas of anæmic infarcts and infection. Bladder and left ureter filled with pus.
02	9.9	Good	Double mattress	1.9	None	11.0	Excellent	Right kidney weighs 40 gm., in fair condition, areas of destruction with replacement by fibrous tissue and round cells. Kidney substance in fair condition.
90	11.3	Good	Double mattress	5	Stone formation	11.0	Fair	Right kidney weighs 43 gm., nodular, generally in fair condition. Stone in pelvis.
0.9	8.0	Good	Mattress		None	8.3	Good	Left kidney weighs 35 gm., in good condition grossly and microscopically. Right kidney weighs 30.5 gm., in good condition.
200	7.0	Good	Double mattress	3	Stone formation	7.5	Fair	Left kidney weighs 29 gm., grossly in fairly good condition, areas of destruction, with fibrous replacement and areas of leucocytes. Incision replaced with scar tissue. Kidney cells in poor condition. Right kidney weighs 31 gm.

destroy a great deal of kidney substance, and the enlargement of the kidney after a short time is due to overwork and not to increased kidney substance, showing that the sum total of kidney substance is reduced by the operation; (5) the destruction of the kidney substance extends far beyond the site of the operation; (6) the functional activity of the kidney operated on is somewhat reduced (the functional activity is determined by estimating the amount of urine secreted and its nitrogen balance); (7) the interrupted sutures caused the least damage, and (8) histologically, great damage was done to the kidney substance.

METHOD OF EXPERIMENTATION

All of my experiments were performed on female dogs. The normal kidney function was established before operation, and the general condition of the animal and its weight noted. The operative procedures were all conducted under ether anæsthesia, employing sterile technique. The kidney was delivered

Fig. 15.

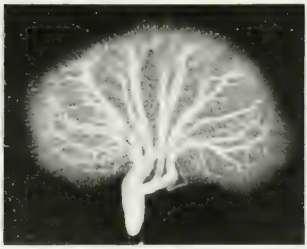

Fig. 16.

Fig. 17.

Fig. 15. Roentgenogram of dog's kidney subjected to nephrotomy with arteries injected with barium sulphate.

Fig. 16. Roentgenogram of dog's kidney after nephrotomy, with the arteries injected with barium sulphate.

Fig. 17. Roentgenogram of a dog's kidney after a nephrotomy, with the arteries injected with barium sulphate.

through a lumbar incision, a rubber-covered clamp was applied to the pedicle and the organ incised from pole to pole. The incision was closed by various methods which will be described, and the wound closed with layer sutures. Following operation the dogs were carefully observed with particular reference to blood in the urine. At intervals they were weighed, examination of the urine was made, and the functional activity of the kidney was determined. Certain of the animals were killed by etherization at intervals varying from 10 days to 6 months. The gross condition of all the kidneys was studied, and microscopic sections were made to ascertain the character of the scar, amount of destruction, and the condition of the tissue at a distance from the line of incision. The kidney function was estimated by determining the blood urea and the excretion of phenolsulphonephthalein. The routine procedure was as follows:

The animal was placed on the standard diet of the laboratory kennels. Blood was withdrawn from the jugular vein. The urea content of the blood was estimated by Van Slyke and Cullen's modification of the Marshall method. One cubic centimeter of phenolsulphonephthalein was injected into the dog's jugular vein, and it was placed in a metabolic cage for 2 hours and 15 minutes. It was given water to drink during this time. All urine excreted was collected at the end of 2 hours and 15 minutes; the animal was then catheterized with a sterile steel catheter, and the bladder lavaged with warm water. All the urines were mixed and the percentage of phenolsulphonephthalein excreted was determined by the use of standards and with the colorimeter. Two urea and two phenolsulphonephthalein tests were made on each animal before operation. The same procedure was carried out at intervals after the nephrotomy. In some cases the amount of urine passed during stated intervals was determined and a chemical and microscopical analysis made.

Site of operation on the kidney. It is known from the work of Hyrtl, Zondek and Broedel that the place of election in incising the human kidney is in the avascular area just posterior to the middle convex line. Cullen and Derge and Kelley assert that the blood supply in the dog is similar to that of man with the exception that, in most dogs, the larger artery passes to the posterior portion of the kidney rather than to the anterior, as in man. In order to corroborate this finding, kidneys, taken fresh from dog and man, were washed clear of blood and injected with barium sulphate solution according to the technique of Gross. Roentgenograms were then made and the vascular network was studied. It was seen that in the kidneys of dogs, the avascular area was larger than in the kidneys of man and in the middle portion of the kidney (Figs. 1, 2, 3, and 4), and that an incision made through this area in the dog would probably cut fewer arterioles than an incision in the avascular zone of the kidney of man. Therefore, the incision used in my experiments was made in

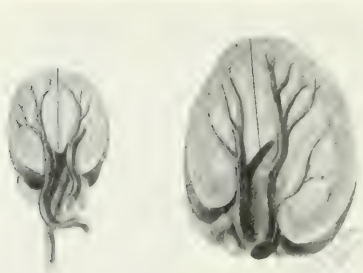

Fig. 18.—Incisions for nephrotomy in man and the dog.

the middle convex line, or just anterior or posterior to it. The scalpel was used in all cases. The kidney was delivered through a lumbar incision and a rubber-covered clamp applied to the pedicle. The kidney was then incised as described, and its wound closed in three ways: (1) three or four deep sutures were passed through the kidney substance and tied over the cortex and a continuous suture was applied through the fibrous capsule (Fig. 5); (2) three mattress sutures were placed through the medulla and a continuous suture through the fibrous capsule (Fig. 6); and, (3) two rows of continuous sutures placed at different levels, one near the pelvis of the kidney and the other at the juncture of the medulla and the cortex, just entering the kidney substance on each side, as suggested by Mann. The ends were tied at one pole and the two halves of the kidney brought together. The two sutures were pulled up and tied, and several stay sutures applied to the fibrous capsule and finally a continuous suture through the fibrous capsule (Figs. 7, 8, and 9). No. 00 catgut was used in all renal sutures.

RESULTS

Four series of experiments were conducted: (1) bilateral nephrotomy at one operation; (2) bilateral nephrotomy with an interval between the two operations; (3) removal of one kidney and a nephrotomy later on the remaining kidney, and (4) unilateral nephrotomy and after an interval removal of the other kidney.

The normal condition and weight of the animals, the type of suture used in closing the nephrotomy wound, the complications and length of life of the dog, and the condition of the animal and its weight at the end of the experiment are given in Tables I and II. The pathological condition of the kidneys as found at necropsy is briefly indicated. The dogs were in good condition in nearly all instances. Continuous mattress sutures were employed in seventeen operations, the deep sutures over the cortex in five, and the mattress type of suture in four. The complications following the continuous mattress sutures were: uræmia, two; hæmorrhage, three; considerable loss of function, two, and stone formation, three. Thus, in seventeen operations there was considerable loss of function in four cases and hæmorrhage in three. In the five experiments in which deep sutures were tied over the cortex, uræmia occurred in three animals and stone formation (Fig. 10) in one of the three. In the experiments in which mattress sutures were used, uræmia occurred in two. Hæmorrhage did not occur with the latter types of suture. In a number of instances, blood was present in the urine immediately after operation; it disappeared in a day or two and no attention was paid to it as it appeared to be a natural sequence to such an operation. Eleven of the animals lost weight; the weight of one remained stationary, and five gained weight.

In general the kidney showed considerable pathological change. The substance of the kidney was depressed along the line of incision in nearly all cases, and many of the kidneys were nodular. In a few instances there was considerable loss in the weight of the nephrotomized kidney when compared with the opposite kidney. The incisions in the dogs killed soon after operation were replaced with blood clot (Figs. 11 and 12), with degeneration of nearby kidney tissue. Later the clot was replaced by scar tissue, as seen in the kidneys of animals killed after a longer period (Figs. 13 and 14). In nearly all, the substance of the kidney in the region of the incision showed destruction of tissue and replacement with round cells and fibrous connective tissue. The microscopical change of

TABLE III.—SUMMARY OF BLOOD UREA ESTIMATIONS AND PHENOLSULPHONEPHTHALEIN TESTS ON TWENTY-THREE DOGS

Dog No.		Normal		Time after operation											
				Two Days	Four Days	One week	Two weeks	One month	Six weeks	Two months	Three months	Four months	Five months	Eight months
SERIES I															
500	1	30	36			116									
	2	70	60			15									
158	1	28	40			98	94	196	90	126	162	144			
	2	50	65			15	45	40	50	30	30	30			
152	1	36	32			42	58	60	48	36	34	22			
	2	55	50				50	45	40	35	60	45			
SERIES II															
120	1	48	46			70	54	32	28	80	28		46	18	
	2	60	55			55	45	55	55	55	50		50	60	
163	1	26	40			44	28	30	44	30	22		30	32	
	2	50	55			45	50	50	50	40	60		40	45	
SERIES III															
556	1	34	32	42			12	24	64	34	34				
	2	65	65				62	60	50	60	65				
99	1	56	70		140	100	68	68	52	40	88		50		
	2	55	55			20	35	60	50	40	35		40		
92	1	52	52		66	68	80	48	66	40	38		22		
	2	60	80		70	50	50	65	50	55	55		60		
129	1	36	32			144	594								
	2	70	70			None	None								
248	1	46	46		422										
	2	65	60												
191	1	40	34			68	80	44	44	42					
	2	70	70				40	45	55	65					
110	1	46	48		72	76									
	2	40	50		60	55									
218	1	52	52			152									
	2	60	55												
627	1	30	36	38			460								
	2	60	60												
249	1	46	32			30	60	44	66	38	38				
	2	60	50				55	55	45	50	50				
625	1	66			50		80	84			84				
	2	30					25	25	30		30				
130	1	32	32			76	64	48	32	70	34		40	20	
	2	65	65			50	55	45	45	30	50		60	60	
219	1	36	40			94	62	26	46	68		108			
	2	60	60			50		50	45	35		None			
250	1	48	44		100	80	76	70	56		36				
	2	60	55			53	50	50	45		45				
SERIES IV															
525	1	14				28					24	22			
	2	60				60		60				60			
391	1	16	8	22			34			24					
	2	60		50			60			50					
524	1	22				34		54				50			
	2	50				50		50							
390	1	32	15	36			38			26			28		
	2	60		50			55			55			50		

*Blood urea estimations, milligram for each 100 cubic centimeters.

**Phenolsulphonephthalein, per cent return in two hours and fifteen minutes.

TABLE IV.—SUMMARY OF TWENTY-SIX NEPHROTOMIES ON TWENTY-THREE DOGS

	Dogs
Stones occurred in	4
Hæmorrhage occurred in	3
Secondary	2
Consecutive	1
Uræmia occurred in	7
Associated with hæmorrhage in	2
Associated with stones in	1
Temporary change in function with return to normal in	9
Slight change in function occurred in	5
Moderate change in function occurred in	2
Great change in function occurred in	7

the substance of the kidney usually followed the functional results; if there was a diffuse degeneration of the kidney cells, the functional loss was great, and vice versa. With all types of suturing, streaks of fibrous tissue were seen along the suture line. This appeared to be greatest in the kidneys in which the mattress sutures were used.

Table III gives in detail the functional tests before and after nephrotomy, Table IV contains a summary of the complications and functional results in 26 nephrotomies performed on 23 dogs.

Hæmorrhage occurred three times, one of the primary and one of the secondary type. Stones were found in the pelvis of the kidney in 4 and uræmia in 7. The latter was associated with hæmorrhage in two instances and stone formation in one. There was a temporary change in function following operation with a return to normal in 9. Five animals showed slight loss of function; 2, moderate loss, and 7, great loss.

In Dogs F99 and F249, the renal artery was injected by the Gross method after nephrotomy. The depression along the line of incision was evident. However, there did not appear to be any appreciable interference with circulation (Figs. 15 and 16). A large soft stone was situated in the pelvis of the kidney of Dog F99 and failed to show (Fig. 17). This kidney was closed by the double mattress technique and there was only slight loss in function. The roentgenograms of the kidney of Dog F249 also showed no interference with the blood supply. This kidney was closed with four deep sutures tied over the cortex and there was practically no loss in function.

DISCUSSION

Clinical results. Hæmorrhage requiring secondary nephrectomy occurred in 4 of 21 cases of complete nephrotomy for conditions other than stone, chiefly for exploration, while in 150 nephrolithotomies a secondary nephrectomy for hæmorrhage occurred only twice. This would appear natural as it is reasonable to suppose that a bleeding kidney would be more subject to hæmorrhage after operation than a non-bleeding one, and as in the cases of stone the incisions into the kidney are of less extent. It was necessary, however, to perform a secondary nephrotomy for infection in 3 cases and for a recurrence of stones in 2. On the other hand it is evident that a single kidney may be subjected to nephrolithotomy and maintain a fair degree of function and support life.

Experimental. Because of the difference in the arterial supply of the kidney in man and dog, the plan of incision to avoid injury to the vessels necessarily differs. The incision as advocated by Broedel is the one of choice for man, while incision in the middle line of the cortex, cutting straight down into the pelvis, will cause the least injury in the dog (Fig. 18).

Hæmorrhage, although occurring in only 12 per cent of nephrotomies, is a real danger. It is associated with destruction of kidney tissue and kidney insufficiency. Kidney insufficiency, however, may occur without hæmorrhage, resulting from a general degeneration of tissue, contraction of the kidney and, in a small number, true infection. It is true, however, that in the greater percentage of cases, except those of hæmorrhage and infection, the operation does not appreciably destroy the renal function. The kidney may be very nodular, its form much distorted, and there may be considerable contracture, but unless there is an associated general degeneration of kidney cells, the function continues

fairly good. This would seem to show that it is not localized multiple areas of destruction that destroy function, but a diffuse degeneration.

The results from the various methods of suturing would indicate that the double mattress type of suture is followed by the best functional results, but the danger of hæmorrhage and stone formation appear to be slightly higher than with the other two methods of suture.

Because of the possibility of hæmorrhage and infection, the operation of nephrotomy, or especially nephrolithotomy, appears to be inferior to that of pelviotomy and pelviolithotomy. Nephrolithotomy is, however, indicated in such cases in which the stone is situated at the end of a calyx or partially protruding into the cortical substance, and particularly when there is infection and with comparatively little danger of secondary hæmorrhage.

CONCLUSIONS

1. The arrangement of the arteries of the kidney differs in man and dog.

2. Complete nephrotomy, bilateral or unilateral, may be performed in dogs with maintenance of life and renal function. A single kidney may be subjected to nephrolithotomy and maintain sufficient function to support life and health.

3. Secondary hæmorrhage is a real danger in complete section of the kidney. Smaller incisions, single or multiple, may be made into the kidney to remove stone, with small risk of secondary bleeding.

4. Generally pelviotomy is the operation of choice in the treatment of renal calculi; however, in selected cases, nephrolithotomy is indicated.

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TRAUMATIC ASPHYXIA; WITH ESPECIAL REFERENCE TO ITS OCULAR AND VISUAL DISTURBANCES

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ON November 3, 1917, Sergeant Z., age 31, was crushed beneath an overturned motor truck, and suffered a violent compression injury of his lower thorax and abdomen. He was extricated by his companions, and after being examined at Field Hospital No. 12, was immediately sent to Base Hospital No. 18 (France).

On admission he was conscious and answered questions quickly and intelligently. He complained of pain about his pelvis and of inability to void. On examination the attention was immediately directed to his face, which was markedly œdematous and of an intense, deep violet color. This discoloration extended over the entire face up to and within the hair line, involved the ears and the neck, and extended down upon the upper thorax, where, however, it was less intense and interrupted by steaks of normal skin. Upon this violet background were numerous petechial hæmorrhages. The eyes were closed and could not be voluntarily opened, due to the excessive œdema of the lids. On forcibly separating the lids, there appeared a complete bilateral subconjunctival ecchymosis. The lips were greatly swollen and bluish black. The discoloration involved to some extent the tongue and mucous membranes of the mouth and the external auditory meatuses.

Examination of the thorax failed to show any serious injury. Fracture of a rib could not be determined. The respirations were deep, slow, and slightly labored, the pulse strong and not especially accelerated. Examination of the abdomen showed a visible and palpable tumor in the bladder region. Pressure about the pelvis was very painful, especially upon the left side. Voluntary movements of the lower extremities were possible but painful. On catheterization a large amount of bloody urine was withdrawn from the bladder. An X-ray plate of the pelvis showed a fracture of the left pubis and ischium with slight displacement of the fragments.

The patient was operated upon by me the day of his admission. A midline incision was made between the umbilicus and symphysis pubis and the greatly distended bladder opened widely. After the evacuation of a large amount of fluid and clotted blood, a ragged tear in the left bladder wall 4 centimeters in length was found, through which blood from an active hæmorrhage about the fracture entered the bladder. The fracture could be felt through the rent in the bladder wall, but the exposure was so difficult that the hæmorrhage about the fracture could not be satisfactorily controlled. The tear in the bladder wall was closed by catgut sutures introduced from within the bladder. The anterior incision in the bladder was closed without drainage. Extravesical tamponade was used to control the hæmorrhage about the fracture. The pelvis was fixed by strapping with wide strips of adhesive.

With the exception of a troublesome bronchitis with bloody expectoration for a few days, the patient made an uneventful recovery. Not until several days after the operation had the swelling of the lids subsided sufficiently to enable the patient to open his eyes, and then he found that he was unable to see distinctly. An immediate ophthalmoscopic examination showed a bilateral retinal œdema and massive hæmorrhages scattered over each disc and macular region. Dr. Lloyd Whitham, then ophthalmologist to Base Hospital No. 18, confirmed my observations, and to him I am indebted for many subsequent notes. Tested roughly, the patient could recognize the approach of an individual but could not recognize him by his features, was unable to count fingers, and could scarcely recognize large masses of color. Even such slight vision declined during his stay at the Hospital and he eventually became quite blind, excepting for a tiny area in the right infero-temporal visual field which could be quite clearly mapped out by Dr. Whitham with the perimeter. The retinal hæmorrhages were slowly absorbed and the gradual atrophy of the discs, manifested particularly by attenuation of the vessels and paleness, was quite evident at time of his discharge.

This tragic result, so far as the patient's vision is concerned, made a great impression upon me at the time but in the stress of subsequent work the whole experience was forgotten. It was recalled by the visit of the patient 2½ years later in Baltimore. He had been sent home from France, for a time had been at the school for the blind at "The Evergreens," Baltimore, and had become a skilled masseur. An examination made in May, 1920, showed a strong healthy man, but one, who, unfortunately, has remained completely blind.

It is not our purpose to review the entire subject of traumatic asphyxia, but rather to confine ourselves to the visual disturbances associated with this condition. We shall, however, briefly summarize the salient features of the condition and then take up in some detail its associated ocular manifestations and visual disturbances. For a full exposition of the subject, reference may be made to the appended literature.

I. CLINICAL SUMMARY

(a) Traumatic asphyxia (*Druckstauung*, Perthes) (*Stauungsblutungen nach Rumpf-*

kompression, Braun) (*Masque ecchymotic*, French clinicians) (Pressure stasis, traumatic apnœa, etc., English and American) is a condition produced by violent compression of the thorax or upper abdomen or both. In all the cases reported in the literature the compressing force has been applied either directly, the individual being crushed under a wagon or other heavy weight, between two parts of a machine, between cars, or by other individuals in a panic; or indirectly, the individual being doubled up by a force which is exerted upon the shoulders or back, bringing the chest in forcible contact with the thighs and knees ("jack-knife" injury). The compressing force is exerted only for a short time (a few seconds to 5 or 10 minutes). The head and neck are not directly injured.

(b) The characteristic lesion from which the condition derives its name is the discoloration of the face and neck. All the cases described in the literature exhibited to a marked degree a deep blue, violet blue, or bluish black discoloration of the face and neck. On first examination this discoloration or "cyanosis" appears uniform, but closer inspection when made has shown in the majority of instances that the bluish background is studded with minute ecchymotic spots or petechial hæmorrhages. The discoloration is usually most marked about the lids, the lips, and the nose; less marked about the ears and neck. It may involve the scalp within the hair line, or extend to, but not within, the hair line. In some instances the discoloration has involved the mucous membranes of the mouth; but more commonly the mucous membranes of the mouth, the tongue, the faucial pillars, the auditory meatuses, and ear drums have been marked by small punctiform hæmorrhages. While this discoloration has, in the majority of cases, involved the face and neck, it has extended downward upon the upper thorax as far as the nipples, upon the upper arm as far as the insertion of the deltoid, and upon the back to the lower border of the scapula. Here, however, the discoloration has never been so deep as upon the face and neck, and usually has been irregular, being interrupted by streaks of normal-appearing skin. In a number of cases (22) the discoloration has been strikingly absent at a point of pressure, as under a collar band, hat band, or suspenders, an observation which has led to the theory that counter-pressure or support of tissues may protect various structures, as the brain and eye, from injury. The discoloration begins to disappear usually on the second to the fourth day and has quite disappeared within 2 weeks. The color appears simply to fade and does not exhibit the chromatic changes seen following the usual subcutaneous hæmorrhage. This observation, repeatedly verified, suggests that the discoloration, presumed by some to be due to an extravasation of blood into the tissues, is due rather to a marked venous stasis.

(c) In addition to the discoloration, there is usually a marked swelling and œdema of the tissues of the face, especially of the lids and lips. Extensive subconjunctival hæmorrhages, usually bilateral, have been noted in practically every instance. In contradistinction to the discoloration of the face, these hæmorrhages during their absorption exhibit the usual chromatic changes. Hæmorrhages from the nose and mouth are noted in 17 of the 127 cases in the literature; and from the ear, associated sometimes with rupture of the ear drum, in 11 cases.

(d) Unconsciousness is specifically noted to have occurred in 44 of the cases. In the vast majority of cases it has been of very short duration. In 4 cases it persisted from 1 to 7 hours; in one case it continued for 2 days. Signs of cortical irritation have been noted in 8 cases, manifested by convulsive movements, restlessness, and irrationality. Associated fracture of the skull has not been noted; nor any symptoms to indicate pressure from an intracranial hæmorrhage.

(e) Other associated lesions have, of course, varied greatly. *Fractures of one to five ribs*, presumably the result of the compressing force, have been noted in 32 cases, fractures of the clavicle in 6 cases, and of other bones (jaw, humerus, radius, pelvis, femur, tibia) in 10 cases. *Symptoms and signs of intrathoracic injury* have been rather common, but as a rule have been slight and have rather promptly disappeared. Hæmoptysis has been noted in 16 cases; signs of pulmonary œdema,

as indicated by frothy sputum and bubbling râles, in 8 cases; hæmothorax in 3 cases. Pneumonia has occurred in 4 cases, in 1 followed by empyema and in 1 by multiple pulmonary abscesses. Pleural effusion followed by empyema occurred in 1 case. Open thoracic wounds have been noted only once. Subcutaneous emphysema has occurred in 7 cases.

Associated *abdominal lesions* have been clinically rather uncommon. Perforating wounds of the abdomen with prolapse of the omentum and intestine were observed by Pierce and Hueter. An exploratory laparotomy was done upon Wiener's case by Depage, who found a hæmoperitoneum, laceration of the spleen, and thrombosis of the vessels of the mesocolon with necrosis of 5 centimeters of the transverse colon. Abdominal pain, rigidity, and vomiting have been noted in a rather small number of cases but have spontaneously disappeared. Injury to the bladder as in our case has not been previously observed, although bloody urine has been noted in one or two instances.

Associated injuries to the extremities we find have included contusions and lacerations and fractures of the various bones. *Cord and peripheral nerve injuries* have been noted in 8 cases. In von Morian's and in one of our cases there was a presumed or certified injury of the spine and cord. Von Morian's case showed a paralysis of the left and weakness of the right leg without sensory disturbances. The condition eventually spontaneously disappeared. Our case showed a prominence in the region of the twelfth dorsal vertebra, complete paralysis of the legs, and marked loss of sensation. A laminectomy showed a fracture of the twelfth dorsal vertebra and laceration of the cauda equina. He completely recovered. Wegner's case showed weakness of the right arm and leg which subsequently disappeared and suggests a central injury. Braun's (paralysis right tibialis anticus muscle), Ettinger's (paralysis right arm), Despard's (paralysis both arms), Stokes's (flaccid paralysis left arm), and Anderwert's (paralysis left radial nerve) cases are apparently examples of peripheral nerve injuries.

2. PATHOLOGICAL SUMMARY (NECROPSY FINDINGS)

(a) *Brain and meninges.* The brain and meninges have singularly escaped injury. Aside from cerebral congestion indicated by engorgement of the pial vessels, Ollivier found a subdural hæmorrhage in only 1 case of the many examined by him. Tardieu failed to find any cerebral lesions in the 2 cases in which examination of the brain was permitted. Braun, Niemann (necropsy by von Recklinghausen), Orth, Bolt, and Robertson in the necropsies upon their cases found nothing noteworthy aside from cerebral congestion. Schultze's case showed a thin film of blood over the hemispheres but no demonstrable rupture of the cortical vessels.

(b) *Tissues of the face and neck.* The characteristic discoloration of the face and neck has been described. The question has naturally arisen whether this is due to an extravasation of blood into the tissues, the result of rupture of the overdistended vessels or to a prolonged venous stasis with paralysis of the vessel walls. Examination of the discolored skin has been made by Beach and Cobb, Winslow, Bolt, Robertson (2 cases), and Braun. The skin has been excised from the neck or chest of living subjects. Beach and Cobb reported that the examination of numerous sections of skin from the neck failed to show any blood in the tissues outside the capillaries. Winslow states that the capillaries were more or less distended but that there was no blood in the tissues outside the capillaries. Bolt found that in a number of sections the skin was normal, confirming the findings of Beach and Cobb and Winslow; but a careful study of further sections showed a few red cells in the tissues outside the blood vessels. Robertson, in the first case he examined, failed to find any hæmorrhage into the tissues but noted a perivascular infiltration in the cutis vera. In a second case examined by him he found blood pigment in, and hæmorrhage and œdema of, the deeper layers of the corium and subcutaneous fat. Braun (examination of skin by Aschoff) found blood in the tissues of the skin outside the blood vessels.

Necropsy examinations, while giving little information regarding the skin, would indicate

that hæmorrhagic infiltration of the tissues occurs as a result of the pronounced venous stasis. In Braun's case there was extensive bloody infiltration of the soft parts of the head, face, mouth, and intramuscular tissues of the neck. In Niemann's case there was a hæmorrhagic infiltration of the tissues of the head, temporal muscles, mucous membranes of pharynx and neck; in Milner's case, of the pharynx and upper larynx, and in Lang's case of the muscles of the head and neck. The clinical observation that the discoloration of the face and neck disappears without chromatic changes and the failure in most instances reported to find extravasation of blood into the skin, would indicate that the discoloration is due rather to a venous stasis than an extravasation of blood into the tissues. The matter, however, requires further study.

(c) *Thorax.* The intrathoracic necropsy findings have been as follows:

Braun's case. Left hæmothorax. Extensive bloody infiltration of the subpleural space, posterior mediastinum along the aorta and right diaphragm. Diaphragm torn from its attachment.

Niemann's case (necropsy by von Recklinghausen). Hæmothorax, subpleural and pulmonary hæmorrhages, fat emboli in the pulmonary arteries.

Lang's case. Rupture of the right lung. Hæmothorax.

Milner's case. Hæmothorax. Laceration of the lower lobes of the lungs.

Henry's case. Innumerable small subpleural hæmorrhages. Collapse of the right lung; partial collapse of the left lung; empyema right; multiple abscesses in both lungs. Thrombosis of the pulmonary artery.

Bolt's case. Congestion and œdema of the lungs.

Robertson's case. Subpleural and pericardial hæmorrhages. Hæmorrhagic consolidation of the lungs. Bronchopneumonia.

Ollivier's cases. Congestion of the lungs, subpleural and pericardial hæmorrhages. Hæmothorax and hæmorrhagic consolidation of the lungs in some cases.

Tardieu's cases. (Findings similar to Ollivier's, above.)

(d) *Abdomen.* The clinical findings in Pierce's and Hueter's and our own cases have been noted. Necropsy examinations have shown the following:

Braun's case. Hæmoperitoneum, hæmorrhagic infiltration of the omentum. Laceration of the liver, spleen, and left renal and suprarenal arteries. Herniation of left kidney into the thorax.

Milner's case. Hæmoperitoneum; laceration of the spleen, liver, kidney, and diaphragm. Perforation of the duodenum.

Bolt's case. Passive congestion of the abdominal viscera.

Lang's case. Rupture of the liver and spleen. Hæmoperitoneum.

3. THEORIES AS TO ITS CAUSATION

Satisfactory explanations of the various manifestations of this condition have naturally been sought by those interested in it. The immediate cause has in all cases been a violent compression of the thorax or upper abdomen or both. The characteristic discoloration of the skin of the face and neck has followed in a few minutes but occasionally has not reached its maximum until the day following the injury. Ollivier concluded simply that death in the 23 cases examined by him was due to asphyxia, the result of violent compression of the thorax. Tardieu does not comment upon the causation of the discoloration of the face. Hueter (1874) suggested two causes for the condition: (1) mechanical, due to back pressure of the blood with dilatation of the vessels of the face; and (2) nervous, due to injury of the sympathetic in the abdomen with a resultant paralysis of the vessel walls in the distribution of the cervical sympathetic. He (with Vogt) tried to reproduce the condition in animals, which will be commented upon later. Perthes was, so far as I can gather, the first to call attention to the absence of functionating valves in the veins of the head and neck as an explanation for the limitation of the area of discoloration. His explanation of the characteristic discoloration was, then, that the increased intrathoracic pressure, the result of the thoracic compression, was transmitted into the veins of head and neck which ruptured, with the extravasation of blood into the tissues.[1] This explanation was accepted for a time by subsequent writers, but the clinical observation that the discoloration during the period of its disappearance failed to show the chromatic changes characteristic of absorbing extravasations of blood, led Beach and Cobb and subsequent observers to

[1] Perthes states that the valves at the junction of the internal jugular and innominate veins (the only valves present in these veins) are incapable of resisting the back pressure of an injection mass starting at the vena cava

examine sections of the skin removed from the discolored areas. As indicated above, the majority has failed to find an extravasation of blood into the skin, and, therefore, the more recent belief is that the discoloration is due to a venous stasis, the result of overdistention with, perhaps, paralysis of the walls of the veins. The matter, however, would not appear to be entirely settled. Bolt's and Robertson's findings in the skin excised from their cases (see pathological findings: *Tissues of Face and Neck*) are somewhat doubtful. Moreover, that extravasation of blood has occurred into the tissues of the face and neck without direct injury to these structures is clear from the autopsy reports. The observation of Robertson that the ecchymotic spots in the skin subsequently became a brownish-yellow suggests chromatic changes.[1]

The almost invariable association of subconjunctival hæmorrhage in this condition has been assumed to be the result of retrobulbar extravasations which have occurred in a number of cases at necropsy. Retrobulbar hæmorrhages have also been assumed to be the cause of the exophthalmos not uncommonly seen in this condition.

Intracranial and retinal hæmorrhages have been surprisingly infrequent. The only explanation thus far offered (suggested by Braun and Wesseley in the same year, 1904) is that the intracranial and intra-ocular pressures oppose the pressure in the vessels and so prevent their rupture. It was suggested by the clinical observation (made in 22 cases) that the characteristic discoloration of the face and neck stops exactly at and is absent under points of pressure such as the collar band, the hat band and the suspenders. It has been accepted by perhaps a majority of the writers on the subject; not accepted by others.

[1] Of interest in connection with the causation of the condition is the case reported by Kredel, Zentralbl f. Chir., 1907, xxxiv, 1472. An infant [illegible] containing the whole liver and the greater part of the intestines. Great pressure had to be exerted upon the liver to reduce it into the abdominal cavity and great force was necessary in order to close the abdomen. At the conclusion of the operation, to the surprise of the operator, the child's face showed a bluish discoloration and was marked by numerous petechial hæmorrhages. The right eye showed a subconjunctival hæmorrhage. Ophthalmoscopic examination failed to show any retinal hæmorrhages. Here, then, in the author's opinion is a physiological experiment, the condition of traumatic asphyxia having been produced by pressure upon the liver. He is of the opinion that the pressure upon the liver caused a great mass of blood to be forced to the right heart and that this pressure was communicated to the large veins of the face and neck.

4. EXPERIMENTAL DATA

The only experimental attempts to reproduce the condition which I have been able to find are those of Vogt and Perthes. Hueter in his paper comments upon the experiments of Vogt on rabbits. Compression of the abdomen, either sudden or continued, caused a dilatation of the ear veins, but no discoloration of the face. Division of the splanchnic nerves in the abdomen caused dilatation of the vessels of the skin but no discoloration of the face. Perthes produced energetic compression of the thorax in two white rabbits and found that there was a dilatation of the ear veins and cyanosis of the mouth and eyelids. He was unable to produce cyanosis of the face and explains his failure as due to the presence of valves in the veins which are capable of resisting pressure.

5. TREATMENT

Excepting a venesection performed upon his patient by Shimonek, there has been no treatment for the condition. The cases have died either immediately following the injury or later from some complication. Shimonek's patient was unconscious and respiration had ceased; the heart "was beating against the chest wall with great vigor pointing to the great obstruction against which it was laboring." Believing that the patient's right heart required immediate relief, he opened the median basilic vein. The blood "flowed in a large black stream" and by the time 1 quart of blood had escaped, respiration commenced and in a short time consciousness returned. The patient recovered.

6. MORTALITY

Of the 127 cases included in this report, 27 were dead as a result of their injuries or died a few moments after being seen. Of the 100 cases which survived the initial injury, 92 recovered and 8 died. Death in the majority of cases was due to extensive injuries of important organs or to infectious complications (pneumonia, empyema).

THE OCULAR AND VISUAL DISTURBANCES IN TRAUMATIC ASPHYXIA

The comment has frequently been made by writers upon traumatic asphyxia that visual

disturbances and retinal hæmorrhages have been rare complications of this condition. The complete loss of vision in our case seemed to us, therefore, a most unusual result and led us to look up the literature on the subject. As no mention was made in many of the collected cases of visual disturbances or ophthalmoscopic examinations, we have with two exceptions (Kossobudzki, quoted by Milner and Wienecke; Roset, quoted by Bolt), consulted the original articles. Including the cases of Ollivier and Tardieu, of Orth mentioned in the discussion of Borchardt's paper, of Edington mentioned in the discussion of Beatson's paper, and our own, there are 127 cases reported in the literature. Leber's 4 cases referred to by Wagenmann are the same as those reported by Voelcker, and are not included. Wesseley's 3 cases mentioned in the discussion of Borchardt's paper, presumably also are included in Voelcker's cases. Somerville's case mentioned in the discussion of Beatson's paper, appears to us atypical and is, therefore, not included. Of these 127 cases, the 23 cases of Ollivier, the case of Niemann, and one of Milner and Schultze, were dead when first examined, and the only notes referable to the eyes which were made are those regarding subconjunctival hæmorrhages and exophthalmos.

SUBJECTIVE VISUAL DISTURBANCES

The only mention of immediate subjective visual disturbances is found in the case reports of Perthes (2 cases), Neck, Braun (2), Scheer, Joynt, Moeser, Le Dentu, Bolt, Lang, Béal (2), Parker (also reported by Eliot), Anderwert and Heuer; 16 cases in all. Three other cases (Beatson, Pierce, and Kock and Roenne) had no immediate visual disturbances, but later complained of failing vision.

1. Perthes's case 1. M. 14. For an hour after regaining consciousness, the boy stated that he was unable to see. Vision later completely returned. No note that an ophthalmoscopic examination was made.

2. Perthes's case 2. M. 36. While being crushed he had the sensation that his eyes were "popping from his head." He stated that he became completely blind almost immediately. Subsequent complete return of vision. Retinæ normal on the eighth day after injury.

3. Neck's case. M. 38. Stated that for half an hour after the accident he was totally blind. Then vision returned in the right eye but failed to return in the left. Impairment of vision in the left eye permanent (visual acuity, 4/12). Ophthalmoscopic examination showed hæmorrhages in the macula of the left eye; right eye normal.

4. Braun's case 1. M. 45. Admitted 6 hours after injury complaining that he was completely blind. Died 30 hours after injury without return of vision. Ophthalmoscopic examination negative.

5. Braun's case 2. M.27. Stated that during and immediately after injury he was unable to see. Later, on examination at the hospital, vision had returned. Author suggests that inability to see may have been due to swelling of lids. Ophthalmoscopic examination negative.

6. Scheer's case. M. 35. After recovering consciousness he noticed that vision in his left eye was markedly impaired. Four weeks later visual acuity, left = 5/30; 8 weeks later, visual acuity, left = 5/10; 3 months later, visual acuity, left = 5/5. Ophthalmoscopic examination showed two hæmorrhages in the left retina; right eye normal.

7. Joynt's case. M. 23. Stated that while being crushed he became completely blind and remained so until a few minutes after he was released. Dimness of vision disappeared at once in his left eye but continued for 24 hours in his right eye. Diplopia for 3 days. No note that an ophthalmoscopic examination was made.

8. Moeser's case. M. 50. On regaining consciousness he stated that he was absolutely blind. Impairment of vision permanent. Five weeks after injury, visual acuity, right = movements of hand at 1 meter; left = 6/35. Six months after injury, visual acuity, right = movements of hand in front of eyes; left = 5/25. Subsequently, right eye became completely blind; left remained 5/25. Numerous retinal hæmorrhages in right eye; one large hæmorrhage in left eye.

9. Le Dentu's case. One of his cases had visual disturbances, but the exact nature and degree are not stated. Ophthalmoscopic examination showed minute retinal hæmorrhages.

10. Bolt's case. M. 38. Stated that he was completely blind for 15 to 20 minutes after injury. Impairment of vision continued for some time, but normal vision was apparently recovered. Photophobia. No retinal hæmorrhages.

11. Heuer's case. M. 31. On opening eyes after accident complained of loss of vision. Three days after injury was able to recognize large moving objects and masses of color; unable to count fingers. Subsequent total blindness. Retinal hæmorrhages.

12. Lang's case. M. 42. Completely blind for 14 days after the accident, then a partial return of vision. At the time of the report the *left eye* had no perception of light, the optic disc was atrophic, the retinal vessels normal; the *right eye* showed 4/5 normal vision, the lower part of the disc was pale and the visual field contracted. The retinal vessels were

normal. There is no mention made of retinal hæmorrhages.

13. Béal's case 1. M. 49. Immediately after injury the patient complained of diminution in vision. Examined a couple of days after the injury he was unable to read the headlines of a journal at 20 centimeters. Opthalmoscopic examination showed attenuation of the arteries. Three weeks after the injury ophthalmoscopic examination showed in the *right eye* an oval macular hæmorrhage, some retinal œdema and attenuation of the arteries. The *left eye* was normal. Three months after injury vision in the *right eye* = counting fingers at one meter; in the *left eye* = 7 opts. There was a bilateral optic atrophy.

14. Béal's case 2. M. 14. The boy stated that for 2 hours after the accident the left eye was completely blind, then vision rapidly returned. There was impairment of vision in the right eye with dilatation of the pupil and loss of light reflex. Ophthalmoscopic examination 8 days after the injury showed *right eye*—disc normal in outline, arteries small, veins engorged and retina œdematous. The macular region showed a classical picture of thrombosis of the central artery with numerous small retinal hæmorrhages Visual field (5 centimeter disc) normal for white and colors. Visual acuity = counting fingers at 50 centimeters. *Left eye*—pupil and reflexes normal. Fundus normal. Visual acuity = 7/10 normal. Four months after injury right eye showed disappearance of the retinal hæmorrhages, diminution in the size of the arteries and marked optic atrophy. Visual acuity = less than 1/10 normal. Left eye—remained as at first examination above.

15. Parker's case (also reported by Eliot). M. 23. Immediately after the injury he had total loss of vision in his right eye. Examination showed right eye—no perception of light and sluggish papillary response. The optic disc was white with great engorgement of the veins and slight retinal œdema, apparently no retinal hæmorrhages. Left eye—vision normal, some engorgement of the veins and retinal œdema; otherwise negative. One month after injury, right eye—blind; no pupillary response, optic atrophy. Left eye—vision normal, fundus normal excepting for venous engorgement.

16. Anderwert's case. M. 26. Stated that for about 10 minutes after the injury he was totally blind. Vision promptly returned. The pupils reacted promptly. There are no notes to indicate that an ophthalmoscopic examination was made. Apparently there was not any disturbance in vision at the time of his discharge.

17. Kock and Roenne's case. M. 54. For 2 days after the injury there were no visual disturbances and ophthalmoscopic examination on the second day showed normal fundi. On the third day after injury the patient complained of "a cloud in front of his left eye" but he could see a candle flame and count fingers. On the fifth day after the injury the left eye was completely blind and showed a reactionless pupil; the right eye showed one-half normal vision; ophthalmoscopically both fundi were normal. The visual field of the right eye was normal. On the eighth day ophthalmoscopic examination showed the left fundus normal; the right fundus, however, showed a small fresh retinal hæmorrhage extending over the border of the disc which was not noticed at the previous examinations. Final examination: The left eye remained blind and there appeared a complete atrophy of the nerve head. The vision of the right eye improved and became five-sixths normal. The hæmorrhage disappeared.

18. Beatson's case. There was no complaint of disturbance in vision after the accident and ophthalmoscopic examination was negative for retinal hæmorrhages. The man was discharged apparently well. About 1 year after the injury the author received a letter from Dr. Ramsay, saying that the patient's eyes had become very much affected and that the ophthalmoscope showed distinct atrophy of both optic discs at their outer aspect, especially marked in the right eye. The visual fields were greatly contracted. Dr. Ramsay feared the loss of sight was progressive and that the patient would ultimately become blind.

19. Pierce's case. M. 21. There were no visual disturbances for some weeks after the accident. The pupils were equal and reacted normally. An ophthalmoscopic examination was not made. At the time of his discharge he complained of impairment in vision and his eyes were examined and fitted with glasses. The author presumes that retinal changes, the result of the accident, were responsible for the visual disturbances.

Of the cases reported in the literature (including our own) 16 are noted to have had immediate subjective visual disturbances. These have been indicated above. In 53 cases no mention is made of the presence or absence of visual disturbances; in 10 cases we can gather that there presumably were no visual disturbances, but the fact is not definitely stated; and in 21 cases it is definitely stated that there were no visual disturbances. In one case (Beatson's) in which presumably there were no immediate visual disturbances, and in two (Pierce's, and Kock and Roenne's) in which it is definitely stated that there were none, subsequent disturbances appeared. When we examine the cases with visual disturbances we find:

1. In 6 cases (Perthes, 2; Braun; Joynt; Bolt; and Anderwert) loss of vision was immediate but the return of vision was very rapid (within 24 hours). In 3 of these cases an ophthalmoscopic examination was made and reported negative for retinal hæmorrhages. In 3 cases there are no notes to indicate that

an ophthalmoscopic examination was made. Braun's first case also falls into this group, but he died before the outcome regarding his vision was known.

2. In 8 cases (Neck; Scheer; Moeser; Heuer; Lang; Béal, 2; Parker) loss or impairment of vision in one or both eyes was immediate, and in all except Scheer's case, permanent. In 4 cases impairment of vision involved but one eye, and in Scheer's case recovery was complete in 3 months. In 4 cases impairment of vision involved both eyes and was permanent. Moeser's, Lang's, and Parker's cases eventually became completely blind in one eye and had one-fifth, four-fifths, and five-fifths normal vision respectively in the other. Our case has remained blind in both eyes after 2½ years. In 6 of these 8 cases, ophthalmoscopic examination showed the presence of retinal hæmorrhages, in the majority about the macular region; in two (Lang, Parker) examination of the fundi apparently failed to show any retinal hæmorrhages.

3. In 3 cases (Pierce, Beatson, and Kock and Roenne) there was no immediate impairment or loss of vision, but subsequently impairment of vision was complained of. Pierce's patient complained of impaired vision at the time of his discharge from the hospital many weeks after his injury. Unfortunately, an ophthalmoscopic examination was not made; nor do we know the patient's subsequent history. The author assumes, in view of the fact that the patient had never previously had any visual disturbance, that impairment of vision was a result of retinal changes due to the accident. Beatson's patient had no immediate visual disturbances and ophthalmoscopic examination failed to show retinal hæmorrhages or other abnormalities. At least 16 months after the patient's injury, Beatson received a communication from Dr. Ramsay stating that the patient's sight had become very much affected, that ophthalmoscopic examination showed atrophy of both optic discs at their outer aspect, especially marked in the right eye, and that the visual fields showed great contraction. Kock and Roenne's patient complained of impairment of vision 3 days after his injury and subsequently became blind in his left eye but retained five-sixths normal vision in his right. An unusual finding was the absence of retinal hæmorrhages in the eye which became blind, the presence of a retinal hæmorrhage in the eye which recovered.

Although the number of cases from which to draw conclusions is small, it would appear:

a. That immediate loss of vision may occur in the absence of retinal hæmorrhages, but that the return of vision is rather prompt The explanation for the loss of vision is not clear. It has been suggested that venous engorgement with retinal œdema is the cause. An analogous disturbance is temporary loss of hearing with rather prompt recovery, as noted in Pichler's and Bolt's cases.

b. That permanent impairment or loss of vision has in the majority of instances been associated with retinal hæmorrhages. Beatson's, Lang's, Parker's, and Kock and Roenne's cases are, however, exceptions and indicate that permanent visual disturbances may occur in the absence of retinal hemorrhages.

c. *Subconjunctival hæmorrhages.* Marked subconjuctival hæmorrhages have been noted in practically all cases. Ollivier specifically states that they were present in only 9 of the 23 dead examined by him; but subsequent writers mention the condition almost without exception. As previously noted, it would appear to be from necropsy examination, the result of a retrobulbar extravasation.

d. *Exophthalmos* has been specifically noted in 27 cases; it has either not been present or is not specifically noted in 100 cases. In a few cases it is noted that it disappeared subsequently; in the majority of cases no mention is made of the outcome of the condition. Necropsy examination in 3 cases has shown the presence of fluid blood in the retrobulbar space or hæmorrhagic infiltration of the retrobulbar fat; findings which in the opinion of the majority are sufficient to explain the exophthalmos.

e. *Pupillary changes.* These are noted in 14 cases, are stated to have been absent in 10 cases, have either been absent or are not specifically noted in 103 cases. The pupillary changes which have been noted have not been constant. In 7 cases the pupils were wide and reactionless, but the patients were uncon-

scious when examined. In 2 cases the pupils were contracted and failed to react; in 1 case the pupils were unequal, the left being larger than the right, but both reacted to light. In 4 cases there was a unilateral dilatation with loss or impairment of the pupillary reaction associated with impairment of vision. The subsequent history as regards these pupillary changes is lacking in the majority of cases. In Braun's case the pupils remained dilated *ad maximum* after consciousness returned and continued so until death occurred 30 hours after the injury. In 1 of our cases the pupils, unequal when first examined, later became equal.

f. *Ocular palsies.* Ocular palsies have been noted in only 2 cases. In Braun's case there was apparently a complete ophthalmoplegia (paralysis of third, fourth, and sixth nerves), the patient being unable to move the globes in any direction. He died 30 hours after the injury. The necropsy examination fails to note any examination of the cranial nerves in an attempt to explain the condition. There was fluid blood in the retrobulbar space and hæmorrhagic infiltration of the retrobulbar fat; no intracranial hæmorrhage. In Joynt's case there was a diplopia (palsy of the sixth nerve?) which persisted for 3 days, then disappeared completely.

g. *Ophthalmoscopic examination.* Ophthalmoscopic examination is stated to have been made in 44 of the 127 cases; was either not made or not stated to have been made in 83 cases. In 11 of the 44 cases in which an examination was made, retinal hæmorrhages were present; an additional case in which the retinæ were examined after death showed retinal hæmorrhages. In the remaining 32 cases in which examination was made, the retinæ are stated to have been normal in 26 cases, and to have shown a hyperæmia, congestion, or œdema in 6 cases. In 8 cases in which retinal hæmorrhages were present, there were definite visual disturbances; in 3 cases there were no visual disturbances. Neither the presence nor absence of visual disturbances, therefore, guarantees the presence or absence of retinal hæmorrhages, and it is possible that more frequent examinations of the fundi in cases of traumatic asphyxia will show that retinal hæmorrhages in this condition are more common than has been supposed.

h. *Perimetric examinations.* Perimetric examinations are noted in only 7 cases. In 2, a central scotoma corresponding to a macular hæmorrhage was found; in 4, the visual fields were contracted in varying degree. In our case a series of examinations showed the gradual disappearance of a small area of retained vision until complete blindness supervened.

i. *Permanent visual disturbances.* As previously noted, 16 cases had immediate loss or impairment of vision following the injury. Six of these cases promptly recovered their vision, and one completely recovered his vision after 3 months. Seven cases had permanent impairment or complete loss of vision. One case died before vision returned and one case is so incompletely reported as to be valueless. In addition to these 16 cases are 3 which immediately after injury had no impairment of vision but which subsequently had impairment of vision. One of these is incompletely reported, and we can form no opinion of the extent of the visual impairment. Of the 127 cases reported in the literature, therefore, we know the outcome of the visual disturbances in 9. These are the cases of Neck, Moeser, Beatson, Lang, Kock and Roenne, Béal (2), Parker, and Heuer, and they may be summarized as follows:

Neck's case. Examination 2 months after injury. Visual acuity, right eye—normal. Visual acuity, left eye—1/3 normal.

Moeser's case. Examination more than 6 months after injury. Visual acuity, right eye—0. Visual acuity, left eye—1/5 normal.

Beatson's case. Examination 16 months after injury. "Vision markedly impaired. Feared patient would become blind."

Lang's case. At last examination (time indefinite). Visual acuity, right eye—4/5 normal. Visual acuity, left eye—0.

Kock and Roenne's case. At last examination (time indefinite). Visual acuity, right eye—5/6 normal. Visual acuity, left eye—0.

Béal's case. 1. Examination 3 months after injury. Visual acuity, right eye—ability to count fingers at 1 meter. Visual acuity, left eye—7 opts.

Béal's case. 2. Examination 4 months after injury Visual acuity, right eye—1/10 normal. Visual acuity left eye—7/10 normal.

Parker's case. Examination 1 month after injury Visual acuity, right eye—0. Visual acuity, left eye —normal.

Heuer's case. Examination 2½ years after injury. Completely blind.

Loss or impairment of vision in these cases has been associated with a progressive optic atrophy. In 5 of the cases, loss or impairment of vision may be explained by the retinal hæmorrhages. In Beatson's, Kock and Roenne's, Parker's, and Lang's cases, some other explanation must be sought; and the only one thus far offered is that it is due to degenerative changes in the retina, the result of vascular stasis with œdema.

ADDENDUM. Since writing the above article another case of traumatic asphyxia has been reported by Thomas M. Green, Surg., Gynec. & Obst., 1922, xxxv, 129. This case is unique in that it is the first instance of the condition recorded in deep sea divers. There are no notes in this report regarding visual disturbances; nor is it recorded that an ophthalmoscopic examination was made.

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PRELIMINARY PNEUMOTHORAX IN LUNG SURGERY[1]

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IN this paper I will discuss the possibility of performing pulmonary operations by means of thoracotomy with pleura free from adhesions and without fear of a pneumothorax. I will not refer to the experience of others except those of our great surgeon, Posadas (prematurely deceased 20 years ago), who, as far back as 1896, operated for hydatid cyst and avoided pneumothorax and its terrible consequences by "harpooning," that is, by drawing the lung close to the wound thus, so to speak, shutting the pleural wound, and then performing the operation.

The spectacle following this operation was most striking because there was a sudden change in the physiological condition of the lungs and pleura; undoubtedly, the patients suffered to some extent as a result. General anæsthesia was used, as a rule, and I think more than once helped to aggravate the condition.

After Posadas' work, little or nothing was accomplished in Argentine in improving the technique for pulmonary operations, although such operations were frequently done because of the prevalence in our country of hydatids of the lung.

At the Institute of Surgery, about 3 years ago, we began using a new technique, to which, and not to a fortunate series of cases, I believe we may attribute the good results and the ease with which we have been able to carry out some pulmonary operations with the pleura free from adhesions and in the presence of a large thoracotomy.

We proceed in the following manner: When a diagnosis of pulmonary affection requiring surgical intervention (most frequently a hydatid cyst) is made, we take a roentgenogram of the thorax and introduce into the pleura of the side affected, a quantity of oxygen, or preferably nitrogen, varying from 300 to 500 cubic centimeters. For this purpose we use one of the types of apparatus employed for the production of artificial pneumothorax in the treatment of pulmonary tuberculosis. Besides those instruments universally known, there are two or three excellent models in Argentine. For a trocar we use an ordinary hollow platinum needle, or that of one of our colleagues—Dr. Zorraquin—with which pleural puncture can be done without the danger of wounding the lung. Two or three days after the first injection a second one of 700 cubic centimeters is given; and 2 or 3 days later one of 1,000 cubic centimeters.

In making this pleural puncture, difficulties may be encountered that indicate the existence of pleural adhesions. If adhesions are found, puncture should be carried out in another region, and the search should be continued until a satisfactory result is obtained, unless one is convinced that the pleural adhesions are so diffuse as to make it impossible to produce an artificial pneumothorax. It goes without saying that in the presence of pleural syntexis or extensive adhesions, intrapulmonary operations can be carried out without the fear of an operative pneumothorax resulting. Otherwise, it follows that the patients who have received the dose of gas above referred to, when examined under roentgenoscopic screen, are found to show no pneumothorax of importance. In such cases, several further punctures may be undertaken, bearing in mind always the susceptibility or individual reaction of each patient.

Generally three punctures are sufficient, and when finished, another roentgenogram is taken which permits of the comparison of the conditions, before and after the formation of the pneumothorax. In this condition the patient is prepared for operation.

The technique of operation is briefly this:

Local anæsthesia (with a freshly made solution of novocaine, one-half of 1 per cent) is the method of choice. It is well to infiltrate an area larger than that intended for the surgical work to assure operating always in tissues totally anæsthetized.

[1] Presented before the Physicians' Club of Chicago, November 4, 1922.

Thoracotomy, simple, with a single rib, or thoracotomy with flap of Posadas which takes in two ribs. Although the physical and roentgenological signs permit the exact localization of the pulmonary lesion with the patient in upright position, we usually prefer the Posadas flap, because the pneumothorax and the reclining position of the patient during operation change slightly the relation of the lesion in the lung to the wound of the thorax.

The flap of Posadas is U-shaped, with the opening of the U backward, and its parallel sides running in the intercostal spaces, close along the edges of the two ribs included in the operation.

The elevation of the musculocutaneous flap brings into view a large surface of the parietal pleura, corresponding to the width of the two ribs and of the three intercostal spaces adjoining. The pleura is incised in the form of the U, and although incision is made briskly, we find that the air does not enter with violence and that the usual phenomena of pneumothorax do not follow.

When necessary, the hand can be introduced through the wide thoracic opening to explore the lung and the pleural cavity. The lung is generally found retracted around the area containing the lesion.

The lung is drawn forward into the wound and, with the pleural cavity well protected, the necessary surgical work is done. If a hydatid cyst is present, it is incised and evacuated or aspirated, and the cavity at once cleansed—a manœuvre that always provokes some cough and difficulty in respiration. The pulmonary wound is then sewed up leaving the lung there. If it is necessary to drain, the lung is fixed to the parietal pleura.

If blood or other extraneous fluid is present, the pleural cavity is carefully cleansed and the pleural wound closed. It is generally not possible to obtain perfect approximation of the pleura, because of the retraction of the pleural flap; but this inconvenience is not of great importance.

The musculocutaneous flap is replaced, the muscular layer being sutured with catgut, and the cutaneous wound with silkworm gut. The patient is kept in bed in sitting posture. Eight days after operation, the sutures are removed from the cutaneous wound, and a new roentgenogram is taken.

In case pleural exudate forms, there is no need for haste in extracting it, even should there be a slight temperature, for it is generally absorbed. The patient must be carefully observed after operation and examined every second day with the roentgenoscopic screen.

The object of preliminary artificial pneumothorax is to produce retraction and disuse of the affected lung, thus making it necessary for the healthy lung to carry on the entire function of respiration. At the same time the pleura becomes accustomed to contact with an extraneous gas, and, when the parietal pleura is opened, contact with the exterior ambient medium does not affect it as it would otherwise.

Preliminary artificial pneumothorax causes retraction of the lung tissue around the lesion and in this way facilitates exploration, for when once the pleural cavity is opened the lesion presents itself immediately to view and is in ready access to the surgeon.

Experience has shown that, in operations on a lung free from pleural adhesions, a slow opening so that the pneumothorax may form little by little prevents the inconveniences produced by a sudden pneumothorax, at least to the extent that such inconveniences are not disagreeable.

Our experience with preliminary artificial pneumothorax produced by our method has been very encouraging. While, at present, we have performed only a small number of these operations, we feel very well satisfied with the results, and naturally we shall increase our experience with it as circumstances permit.

CONGENITAL HYPERTROPHY

Report of a Case with Diffuse Neurofibromatosis

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CONGENITAL hypertrophy is by no means an extremely rare affliction, but the unusual pathology in the case under consideration warrants a brief discussion of the subject.

Broca, in 1859, was probably the first to report the condition; since then there have been numerous cases in literature. Autopsies by McGregor, Arnheim, Wagner, and others offer no suggestion as to a possible cause. Gardiner collected 28 cases with 6 autopsies. E. G. Hall, in the *British Medical Journal*, reports a case associated with telangiectatic spots on the entire body. Finlaysin, in 1884, describes a similar condition with patches of cutaneous congestion. Kirvall operated on one case and found mainly fatty tissue. Ballance, in 1890, and Corbin, in 1920, respectively, report cases with deficient mentality. McGregor's case showed at times vasomotor disturbances. In Morbins' case there was a tenderness over hypertrophied extremities, for which reason he considers the condition a morbid entity. No operations were performed or sections made. Redard could find only the fatty tissue involved and attributed the condition to a change in the lymphatic system. Jordan distinguishes two types of elephantiasis, one a diffuse neurofibromatosis involving the nerves; the other, cutaneous structures and muscle tissue. He believes that the blood vessels give origin to the new tissue.

About 70 cases of various types of congenital hypertrophy have been reported in the literature to date but none exactly resembles the case under discussion.

Congenital hypertrophy may be confined to one side, one extremity, one or more fingers or toes—unilateral or bilateral. The fatty tissue predominates, and may be of an embryological type. In our case the condition was not apparent until one and one-half years of age, but from the slow onset, and the early age, we regard the condition congenital. However, from a pathological standpoint, it does not resemble any case of congenital hypertrophy which we could find hitherto reported.

From a clinical standpoint we thought that the origin was probably lymphatic, but as the preponderance of evidence from four of the most eminent authorities in this country consider the tissue a type of neurofibroma, we naturally concur.

Report of the case is as follows:

A. L. E., white girl, 14, admitted to the Crippled Children's Hospital-School, February 21, 1920. Family and past history uneventful; normal labor; walked at age of 1 year; no abnormality until 1½ years of age, when mother noticed right ankle and foot larger than left. Shortly thereafter enlargement of the entire extremity was apparent. This relative difference in length and circumference increased until present condition existed.

Physical examination revealed a healthy girl of 14, with no abnormalities bearing on the subject in question, except the lower extremities. The left lower extremity was normal; the right showed marked hypertrophy in circumference and length with distortion of knee and ankle. The patient walked with great difficulty, using the hand on the right knee, which was in valgus with external rotation of leg; weight was borne on the dorsum of a club foot (equinus varus third degree). The skin was soft and flabby, otherwise normal. The entire extremity beneath the deep fascia was infiltrated with a diffuse, lobulated tumor, which could not be differentiated from the muscles. There were lobules and cylindrical masses, 1 to 2 inches in diameter, and of indefinite length. There was greater hypertrophy on the posterior aspect of the upper two-thirds of the thigh and calf. On deep pressure there was distinct tenderness over the entire extremity but accentuated over the posterior thigh and calf.

Measurements. Circumference of left thigh, 12 inches; right thigh, 16 inches; left calf, 9 inches; right calf, 12 inches. Length of lower left extremity, 30 inches. Length of lower right extremity, 35½ inches. (From anterior superior spine of ilium to tip of inner malleolus.)

Muscle power was diminished, which can be expressed by considering as normal ++++. Hip: flexors ++; adductors ++; abductors +; internal rotators +; external rotators ++. Knee: extensors +; flexors ++ (genu valgum). Ankle: dorsi flexors +; plantar flexors +; abductors +; tibials (equino varus). Blood count and hæmoglobin normal. Wassermann negative; urine negative.

Fig. 1. Fig. 2.

Fig. 1 (at left). Before operation.
Fig. 2. After operation.

Roentgenograms of bones of left lower extremity normal; right lower extremity showed increase in length, decrease in diameter, structural atrophy.

A diagnosis of elephantiasis had been previously made and on account of the almost useless condition, amputation advised. In this we could not concur, though we believed the origin lymphatic, but the skin and superficial fat were apparently normal and the entire distribution of the tumorous tissue was beneath the deep fascia and intramuscular.

We also considered the possibility of an arterial or venous angioma, so decided to remove a section for examination. The patient was sent to the Baptist Hospital and a small incision was made over the dorsum of the foot. The skin and subcutaneous fat were normal as was the deep fascia. Beneath the fascia we found lobulated, yellowish masses intermingled with the tendons and somewhat more dense than fat. A liberal portion was excised, no undue hæmorrhage was encountered, and the wound was closed in routine manner. Laboratory reported embryonic lipoma and connective tissue. Two weeks later a more extensive procedure was undertaken, making an incision on the posterior aspect of the leg from the knee to the ball of the foot (using tourniquet). The skin, superficial and deep fascia was normal, below which was found long cylindrical masses, rather firm, 1 to 1.5 inches in diameter and extending for 10 or more inches. One continued into the thigh, through the popliteal space. These terminated in dense cords, which divided in an aborescent manner. Numerous cysts, with serous fluid, were disseminated throughout. There were also many associated irregular lobules closely resembling fat; at certain points we thought that these cylindrical masses were developed from the tendon sheaths, though their origin was by no means definite. The tumor tissue was diffused through the muscles, adherent, and in places spread out over the muscles so that it was impossible to excise *in toto* without destroying muscle tissue. At least one quart of this material was removed at the second operation, and equally as much at two subsequent procedures on the thigh. Healing after each was primary when we decided to attack the skeletal system. As the right femur was 4 inches longer than the left, we did a plastic shortening, though we were in doubt as to

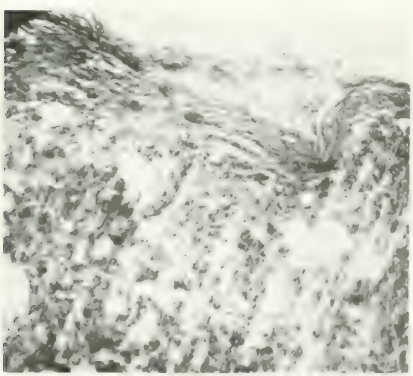

Fig. 3. Section 1. Low power photomicrograph showing the general loose arrangement of the cells in the tumor and the definite encapsulation.

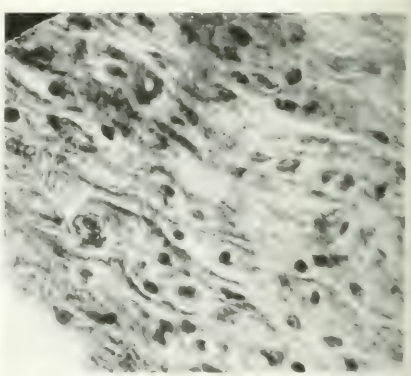

Fig. 4. Section 1. High power photomicrograph showing the large amount of poorly demarcated intracellular material with sparsely placed, regular nuclei.

the affect of such an extensive removal of bone continuity on the already depleted muscular apparatus. The following technique was employed at the Baptist Memorial Hospital, November 6, 1920:

After applying tourniquet, an incision of 10 inches in length was made over the lower two-thirds of the external aspect of thigh, through skin, superficial fat, fascia, and muscle to bone, exposing about 8 inches of the femur. With a motor saw the bone was severed transversely 4 inches above knee joint. In the same manner the anterior half of the shaft, in the upper fragment, was removed for 3 inches, then the posterior half of the lower fragment for 3 inches; 1¼ inch of each fragment was then removed and the extremity of each fragment trimmed to a sharp point, after which the upper and lower fragments were placed together, the upper extremity of the lower fragment extending into the marrow cavity above and the lower extremity of the upper fragment into the spongy bone of the lower fragment. With the drill, holes were made through both fragments and small bone pegs from the redundant bone inserted. After this the limb was unusually firm. The wound was closed in layers with routine dressings and plaster cast. Recovery was uneventful. In 6 weeks solid bony union had occurred. It was thought that further reduction in length could be accomplished through operative correction of the equino varus. Consequently, on March 2, 1921, the patient was returned from the Crippled Children's Hospital to the Baptist Memorial Hospital. An incision was made over the antero-external aspect of the ankle just internal to the fibula and extending to the middle of the cuboid bone (my usual incision for astragulectomy). This passed through the fascia to the ankle joint, just external to the extensor longus digitorum tendons giving excellent exposure to the astragulus when the foot was held in equinus. The astragulus was dissected loose from attachments and removed. The lower 1 inch of both bones of the leg was amputated with saw; a new ankle joint was then constructed with sharp chisel, reproducing both malleoli. A tarsectomy with removal of the articular surface of the pockets was made on either side of the calceneum, near the anterior extremity, for the reception of the malleoli. The foot was dislocated backward and parts approximated. Stitches of No. 2 chromic catgut were placed through the external malleolus and scaphoid, calcaneus and cuboid. The wounds were closed in routine manner with foot placed at right angles to leg. In other words, a modification of "Whitman's astragulectomy." The removal of the astragulus and lower 1 inch of both bones of the leg restored relative length desired. A plaster cast was worn for 8 weeks, when the foot was found to be in excellent position and perfectly stable. A destruction of the lower epiphysis in the leg was permissible as there was excessive growth at other points in the extremity.

At present after four operations on the soft parts and two on the skeleton, the measurements are as follows:

Fig. 5. Gross specimen showing the cords of tumor tissue tapering off into aborescent branches at the ends. The cord from which this specimen was taken was over 3 feet in length, extending from the ankle to the upper thigh, and clearly following the course of the sciatic nerve and its branches.

Circumference: right thigh, 14¾; left thigh, 13¾; right leg, 10¾; left leg, 9¾. Right anterior superior spine to tip of inner malleolus, 32 inches; left anterior superior spine to tip of inner malleolus, 32 inches. (Both limbs same length.)

The correction of deformity and removal of excess weight has materially enhanced the functional efficiency of the limb, especially knee action. The stability of the foot, with properly distributed weight-bearing is an obvious asset. There is some laxness in the knee joint but sufficient stability to walk with only a slight limp, which should materially improve in time. A simple knee brace has been employed to the present time, although she is able to walk without support. The apparatus should be discarded in a few months.

About 3 years have elapsed since the first operation and there is no sign of recurrence.

Pathological report. The tumor lay entirely below the deep fascia of the thigh and leg, apparently arising from the lymphatic channels running along the large vessels and nerves and in the fibrous intramuscular septa. It was arranged in cord-like manner, ½ to 3 centimeters in diameter. In many places it grew down a muscle bundle, such as the posterior tibial, almost completely replacing the muscle, causing a disappearance of the muscle fibers, not by invasion but by pressure atrophy. The tumor was encapsulated, at no place breaking through the capsule and invading the surrounding tissue. The cords of tumor tissue extended from the upper thigh

to the foot, a distance of about 3 feet. On section it was pale, translucent, not friable, with very few blood vessels, and each lobule was surrounded by a fibrous capsule.

The tissue took the routine hæmatoxalin and eosin very poorly.

Microscopical sections showed a loosely connected tissue composed of fibrous strands and rather sparsely placed nuclei, varying in size from small, round nuclei to moderate sized, oval and spindle shaped. The cell outlines were very indistinct and the cytoplasm stained very faintly. Between the cells and fibrous frame work was a hæmogenous material, apparently coagulated lymph, resembling a chronic œdema. There were no lymph spaces or channels. The chromatin was normal in amount, regularly arranged, and there were no mitotic figures. Each field contained one or more small round cells with eosinophile staining granules, and a small eccentrically placed nucleus, size and shape much like a plasma cell. The tumor had not broken through its capsule at any point.

In the fibrous septa between the main tumor lobules, were small strands of tissue the structure of which resembled that of a nerve and in which one pathologist states that he identified nerve tissue. This further suggests that the tumor was of perineural origin. Sections of the bone removed at operation showed atrophic changes, otherwise normal.

In conclusion I desire to express my appreciation to Col. George R. Callendar, Curator of the U. S. A. Medical Museum, and to Major James F. Coupal, Acting Curator, for their co-operation in the preparation of this paper and to Doctor Frank B. Mallory, of Boston, Dr. Albert C. Broders, of Rochester, Minnesota, Dr. James Ewing, of New York, Dr. Joseph C. Bloodgood, of Baltimore, and Dr. N. E. Leake, of Memphis, for the examination of the tissue.

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BILHARZIAL APPENDICITIS[1]

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INFECTIONS of man with the trematode parasite schistosoma are very common in certain parts of the world but even in these localities cases in which the symptoms are confined to the vermiform appendix would seem to be of extreme rarity.

There are believed to be two distinct varieties of schistosoma (1): schistosoma hæmatobium, described by Bilharz in 1852, the more common of the two, found chiefly in Africa, but also in Persia, Arabia, India, Panama, Cuba, and Porto Rico; and schistosoma japonicum, found in Japan, China, and the Philippines.

The commonest sites (2) of infection are the bladder and urethra, rectum, vulva, and vagina. Urinary symptoms, especially hæmaturia are the most common. The bladder lesions consist of patches of hyperæmia which later develop a "sandy" appearance due to the presence of enormous numbers of ova. Chronic inflammation develops with the formation of connective tissue, and this condition may lead to ulceration, phosphatic deposits, and stone formation.

Another type of lesion is hyperplasia affecting the mucosa with the formation of papillomata, in which malignancy may develop. Fistulæ, starting from the neck of the bladder or membranous portion of the urethra, are not uncommon. These arise in a mass of chronic inflammatory granulation tissue which contains large numbers of ova. Similar granulation-tissue tumors may arise in the region of the external genitalia, or in the groins.

Infection of the rectum produces symptoms of dysentery, with mucous and bloody discharges. Here too the lesions are chronic inflammatory with the formation of a mass of vascular connective tissue accompanied by ulceration, and also hyperplasia affecting the mucosa with the production of adenomatous polyps. Ova are abundant in the mucosa and submucosa. Most frequently the rectum only is involved, but in severe cases the entire large, and even the small, intestine may be affected.

Bilharzia infections are much rarer in the female than the male. Burfield (3) quotes the proportion of male to female infections as 24 to 1. In women as in men the most frequent symptom is hæmaturia, but there is often an acute vaginitis with or without involvement of the vulva where condylomata may be found. Horwood (4) describes the formation of a polypoid tumor of the cervix containing large numbers of ova.

Just how this parasite invades the human body is not known but it is presumably by way of the mouth, or through the mucous membrane of the urethra, vagina, or rectum, or possibly through the skin by means of contaminated water used for drinking or bathing. The ova, discharged in urine or fæces, quickly burst, when these discharges are diluted with water, and a motile ciliated embryo is extruded. It is presumably this form of the parasite which invades the tissues. It is argued that infection by mouth is improbable because these embryos seem not to survive an acidity equal to that of the gastric juice. Adult, sexually active forms are found only in the portal system. Worms in copula have been found in cases of rectal infection in the hæmorrhoidal veins, with large numbers of eggs in the surrounding rectal tissues. Similarly worms have been found in the vesicoprostatic plexus with eggs in the bladder mucosa. Postmortem, large numbers of eggs are commonly found in the liver. It is assumed that early development takes place in the liver and that the worms travel against the portal stream to its tributaries about the rectum, bladder, or elsewhere, and that eggs are here laid and are either carried back to the liver by the blood stream or are distributed

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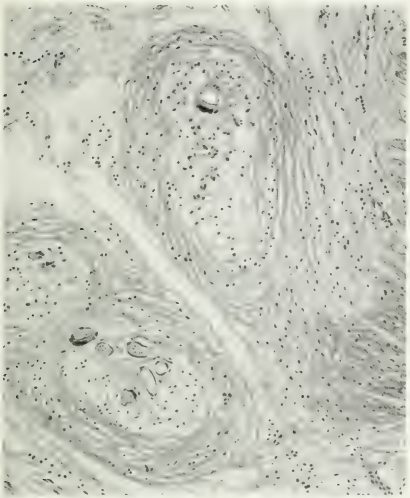

Fig. 1. Shows three tubercle-like nodules in the mesoappendix. In the upper is an empty shell enveloped by a giant cell. In the lower left are seen two giant cells only. In the lower right are six ova, the one farthest to the left being partially enveloped by a giant cell. (Drawing by Alfred Feinberg.)

locally. Possibly there is a greater disposition to the latter when the vein is completely blocked, as it apparently often is, by the worms and the endarteritis produced by them. The possibility is not to be dismissed, however, that the embryos reach their sexually mature form in the small vessels at, or near, the site of invasion and there produce their eggs which are distributed locally and to the liver.

The writers have been able to find but two reported cases in which symptoms of bilharzia infection were confined to the appendix. One, by Burfield (3), was a male, 36 years old, who came from South Africa in 1905 for the treatment of a sinus of 18 months' duration in the right gluteal region. In 1899 he had had a slight attack of appendicitis. In 1902 a swelling appeared in the right iliac region which, a few months later, pointed in the right lumbar region, was incised and drained for a long time. In 1904 an abscess appeared in the right gluteal region. The appendix region was explored and a retroperitoneal abscess found which

Fig. 2. Shows a very fibrous nodule in the center of which is a single ovum showing what is apparently a polar spine with a giant cell on either side. (Drawing by Alfred Feinberg.)

was drained posteriorly and was still discharging when seen by Burfield in 1905. Burfield operated and found the distal portion of the appendix sloughed. The proximal portion he removed. Sections showed abundant ova in the submucosa and the lesions found, according to his pathological description, correspond almost exactly to those in the appendix to be described. The patient had no symptoms of genito-urinary or rectal involvement and Burfield believes that the case was primarily an ordinary acute appendicitis with abscess formation, and that infection with schistosoma occurred only secondarily through the resulting sinus. In the light of the chronic history and with the knowledge from the case here reported that schistosoma can produce an appendicitis without clinically evident lesions elsewhere, it seems more probable to the writers that the primary lesion was produced by schistosoma.

The other case is one reported by Kelly (5). He says: "Aireton relates a case of bilharzia disease in which eggs of the parasite were lodged exclusively in the appendix." There is no further description of the case and no reference.

The writers have seen sections of one appendix, other than that here reported, which was infected with schistosoma. These slides are in the collection of the department of pathology in the College of Physicians and Surgeons, New York, and are from a young Chinese autopsied in Singapore by Dr. W. G. MacCallum. The writer is indebted to Dr. Mac-

Callum for examining some of the slides from the case here reported and for an account of his own case. Briefly, the man suspected of beriberi was infected with ascaris, ankylostoma, and schistosoma japonicum. The spleen and liver were both enlarged, the latter containing large numbers of schistosoma eggs. The stomach, duodenum, pancreas, and adrenals were normal. The upper ileum contained ascaris and ankylostoma. In the colon were yellowish patches which showed thousands of schistosoma eggs. The bladder was normal. Dr. MacCallum (6) says: "The liver, colon, and mesenteric glands show abundant eggs surrounded often by giant cells and tubercle-like capsules. These eggs are about the same size of those in your specimen. I can see no spines, but in sections with shrunken eggs that would be very difficult to be sure of anyway. The lesion is almost exactly the same as my sections show, apparently though it should be the African form and not the Eastern one."

Mrs. W. J. M., age 25, married 1 year, born in Scotland; *lived in South Africa* until 15. Measles lightly at 4; scarlet fever and diphtheria, mild attacks, at 18. Usually well and vigorous but always somewhat underweight. Moderate constipation, about 5 years, necessitating daily laxatives. Nothing abnormal ever noted in appearance of stools. Menses began at 12, epochs every 21 to 28 days, scanty, lasting but 2 days and with great pain first day. No contraceptive measures taken but never pregnant. Slight mucoid leucorrhœa several years.

Chief complaints: (1) sterility, (2) dysmenorrhœa, (3) frequent dull pains in right lower quadrant of abdomen for nearly 2 years. These pains are localized, bear no relation to urination, menstruation, or digestion, and are not influenced by exercise.

General physical examination revealed nothing abnormal. Abdomen thin and slightly retracted. Right kidney just palpable, felt normal. Slight tenderness on deep palpation over cæcum but no abnormality felt.

Pelvic examination discovered a uterus, two-thirds normal size, anteflexed, retrocessed, mobile, with small cervix and tiny external os. Appendages normal.

Urinalysis: A specific gravity, 1025; acid, no albumin or sugar, no formed elements in sediment. Wassermann negative. Blood: reds, 4,256,000; hæmoglobin, 90 per cent; leucocytes, 8,050; polymorphonuclears, 62 per cent; lymphocytes, 38 per cent.

Pre-operative diagnosis: Undeveloped uterus, anteflexed, retrocessed with stenosis of cervix. Chronic appendicitis.

Operation Woman's Hospital, by Dr. Bullard, February 26, 1921: Dilatation of cervix and insertion of stem pessary; appendectomy; Simpson technique of shortening round ligaments. Tubes and ovaries normal. Uterus normal but small, retrocessed, and very mobile. Gall bladder and kidneys felt normal, and all other structures seen or felt seemed to be normal. The appendix was about 2 inches long and of average diameter. There were no adhesions anywhere about. The entire mesoappendix and the distal two-thirds of the appendix were thickly studded with tiny grayish-white nodules resembling tubercles. The appearance was of a chronic lesion. The cæcum was not involved and careful inspection of intestines, omentum, and pelvic organs failed to find any more such lesions. There was an uneventful convalescence.

Two months later the stem pessary was removed. Pelvic examination found uterus in normal position and adnexa normal. No tenderness over cæcum. No abdominal pain or dysmenorrhœa since operation.

Pathological report. The specimen is an appendix 55 millimeter long by 7 millimeter in diameter with an attached thick mesoappendix. The lower half of the appendix and especially the mesoappendix show on the surface numerous small nodules up to 1 millimeter, or slightly more, in diameter. These resemble tubercles but are more glistening, and translucent than are conglomerate tubercles apt to be when they have reached the size of these lesions. On gross section, except for moderate apparent fibrosis, there are no definite lesions. The lumen is empty.

Microscopical. Sections show very numerous nodular lesions about the size of and very similar in appearance to tubercles. None of these is seen in the mucosa, there is a moderate number in the submucosa, and none in the muscular layers, but in the serosa and throughout the entire thickness of the mesoappendix, especially close to the appendix, they are extremely numerous. In these nodules are seen sometimes one ovum, sometimes six or more, with a very definite cell membrane. Sometimes they are of fairly regular oval form but more often partially collapsed. The shell may be empty, filled with granular material, or contain numerous very small, round, hæmatoxylin-staining bodies, resembling nuclei. Some ova are calcified. By the search of serial sections two ova were found which possessed what was apparently a spine, in both cases terminal. One of these ova is shown in Figure 2. Frequently one or more giant cells with many nuclei lie adjacent to, or apparently completely envelope, an ovum. Rarely an ovum is seen lying in the tissue with practically no surrounding tissue reaction but nearly always the tubercle-like nodule is seen consisting of large mononuclear cells, with an occasional giant cell, immediately surrounding the ovum and outside of this a fibrous capsule. In what are presumably the older lesions, dense fibrous tissue immediately surrounds the ovum with very few cells of any kind. In large areas of the mesoappendix, the tissue between the nodules is densely infiltrated with neutrophile

and eosinophile polymorphonuclear leucocytes, but no tissue necrosis is seen anywhere.

When the diagnosis was made, by examination of sections of the appendix, it seemed probable that all information possible had not been obtained from the blood count made by an interne on February 25 and recorded simply as leucocytes, 8,050; polymorphonuclears, 62 per cent; lymphocytes, 38 per cent. Consequently the patient was asked to report for a blood examination which she did on April 1, 1921. Her leucocyte count at that time, done by the writer, was 5,600; polymorphonuclears, 24 per cent; small lymphocytes, 52 per cent; large mononuclears, 7 per cent; eosinophiles, 17 per cent. A stool brought in was carefully searched but no ova were found.

The patient sailed for Scotland in May, 1921, bearing a record of her case to Professor Jonathan Meakins, University of Edinburgh. A report from him stated his concurrence in the diagnosis of intestinal type of bilharzia. "I think it probable that the parasite has become lodged in the muscular coat or probably the subperitoneal layers where it continues to exert a systemic reaction as evidenced by the eosinophilia, although not discharging ova into the lumen of the bowel. Professor Ashworth could find no ova in the stool." He concurred in Professor Meakins' opinion. Sodium antimony tartrate was given intravenously in ascending doses of a 2 per cent solution every 2 days beginning with 1 cubic centimeter. When a 4 cubic centimeter dose was reached, no further increase was made. After 7 doses the patient had taken a total of 22 cubic centimeters. Each dose was mixed with 50 cubic centimeters of normal saline.

Patient returned to New York in July, 1921, free from all symptoms. Abdominal and pelvic examination negative. Eosinophilia, 10 per cent. Three doses of 2 cubic centimeter each, of sodium antimony tartrate, were given intravenously July 12 and 15, and August 9. Eosinophilia August 9, 8 per cent. Patient had by then gained in weight and strength and tiring of treatments, refused more.

On May 2, 1922, the patient's urine was normal. Her blood count was as follows: red cells, 4,300,000; hæmoglobin, 85 per cent; white cells, 10,100; polymorphonuclears, 68 per cent; small lymphocytes, 23 per cent; large mononuclears, 7 per cent; eosinophiles, 1.5 per cent; basophiles, 0.5 per cent.

The patient went to Scotland again in June, 1922, and a report from Professor Meakins, dated August 10, 1922, stated that she was in excellent health and that careful observation failed to disclose any evidence of bilharzia remaining.

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A THIRD OMENTUM

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THERE has come to our attention a slight deviation from the usual development of the gastrohepatic omentum which we believe to be of sufficient importance to bring before the profession, especially inasmuch as no reference could be found in the literature to this very unusual condition. During the routine work at this station, we have chanced upon two cases in each of which there was an additional omentum much like the greater omentum, but instead of being dependent from the transverse colon was dependent from the lesser curvature of the stomach. At operation no pathological conditions of any kind were found in the upper half of the abdomen. The additional loop of omentum, therefore, was not the result of an inflammatory condition in which there had been a separation of omentum in an attempt to localize an inflammatory process, but appeared to be a distinct developmental variation.

Not being content with our inability to find any mention of this rare condition in the literature at our command, we wrote to Dr. Arthur E. Hertzler, Kansas City, Missouri, asking him if he had ever come across this anomaly. His reply was as follows:

"I am very much interested in your anomaly of the omentum. I have never seen anything so extensive. One sometimes sees embryos in which there is a folding downward of the lesser omentum somewhat in imitation of the usual down-looping of the great omentum. I have seen this down one inch or so in the adult stomach, but not down as far as yours. One sees, too, sometimes, a separation of the peritoneum from the stomach, much as one sees often about the cæcum after appendicitis. This is due to subperitoneal changes. I know of no literature on the subject. I have a card index of some ten thousand papers, and I do not remember seeing anything on the subject in that list."

CASE REPORTS

CASE 1. E. T. B. The mother living and well; the father dead, 76, influenza; three brothers and two sisters living and well; two brothers dead, one of typhoid fever and the other killed. Maternal uncle died of cancer. No tuberculosis or insanity in family history.

Chief complaint: gnawing pains in stomach; tenderness in epigastrium; belching; eructation; constipation; occasional headache.

Patient had measles during childhood; small-pox at 20 years of age; machine-gun bullet in back, October 2, 1918; Neisserian infection March, 1921.

In December, 1918, patient was sent to Base Hospital No. 14, Mars-Sur-Allier, France, and received treatment for one month for "stomach trouble." First year after discharge worked at odd jobs around hotels and restaurants. In May, 1920, was under government observation for "stomach trouble." Believed it was growing worse.

Physical examination. Height 68 inches; weight 173 pounds. Examination negative except as follows: Pharynx congested; tonsils enlarged; teeth in poor condition. Blood pressure: systolic 140, diastolic 90. Tenderness over McBurney's point. Knee jerks equal but exaggerated. Diagnosis: appendicitis, chronic; pharyngitis, chronic; gingivitis; tonsillitis, chronic; dental caries.

Operative notes. A right rectus incision was made through skin and superficial fascia. The right rectus muscle was split. The abdomen was opened. The spleen, kidneys, intestines, stomach, duodenum, gall bladder, and liver were examined. The appendix was removed. Pathology: lesser curvature of patient's stomach was absolutely free from any appearance of ulceration. He had what we may consider a third omentum attached along the lesser curvature of the stomach and hanging down over the front of the stomach to about half its width. The gall bladder was apparently normal. There was a marked cholecystoduodenal ligament which is an anatomical affair rather than adhesions. The duodenum was rather large. The appendix was large and acutely kinked about one inch from its tip. The walls were markedly thickened. Contained liquid fæces.

CASE 2. F. W. B. Father living and well; mother dead, cause unknown; four sisters living and well.

Chief complaint: feeling of fullness in abdomen following ingestion of meat and rich food; pain in lower abdomen when he exerts himself.

Patient had measles and mumps in childhood. No other illnesses until submucous resection of

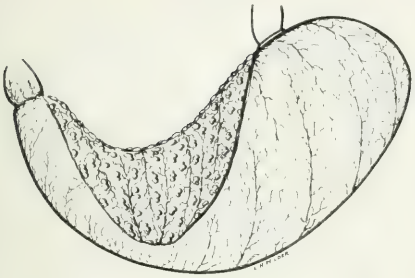

Fig. 1. Semidiagrammatic sketch of condition found in Case 2.

Ft. Riley, Kansas, in December, 1917. Influenza in 1918; was confined to barracks for 2 weeks. In hospital about 3 weeks at Vichy, France, with tonsillitis, in March, 1919.

Since discharge patient has had constant pain in right side, as well as ulcers on right leg. He says he has never been sick a day in his life until induction into army. Thinks present condition was due to exposure and is getting worse. Claims to have weighed 180 pounds when he went into service, and 120 pounds on discharge.

Physical examination. General appearance: rather poorly nourished. Weight 124 pounds. Height 68 inches. Clinical findings negative except as follows: The thyroid is slightly enlarged; palpebral fissure wide; suggestive of von Graefe's sign; pharynx injected; tonsils embedded. Chest: hyposthenic type. Lungs: percussion note slightly impaired in left apex and breath sounds harsh throughout. No râles. Tenderness in epigastrium and left upper quadrant. Can feel large bowel and gas in left upper quadrant. Can hear gurgling of gas on pressure. Tenderness in right lower quadrant. Four small superficial ulcers in lower third of right leg, inner aspect. Numerous scars of healed ulcers on right leg.

Roentgen-ray report. Preliminary examination shows no gross pathology of kidneys or gall bladder. Fluoroscopic and roentgenographic examinations show stomach to be somewhat hypotonic, fish hook type, and somewhat ptosed. The movability of the stomach is normal and the peristaltic action is good. There is a small, constant filling defect near the pylorus on the lesser curvature. The duodenal cap is unusually large but regular in outline. No abnormalities noted. At 6 hours the head of the meal was in the descending colon and the tail in the terminal ileum. The stomach was empty. At 24 hours the meal extended from the cæcum to the rectum and at 48 hours the meal had been discharged. The colon appeared to be spastic. Conclusions: There is apparently an ulcer on the lesser curvature near the pylorus.

Fig. 2. Roentgenogram showing constant defect on lesser curvature, Case 2.

At operation the stomach was found to be normal in every respect. Over its anterior surface, however, there was a small triangular omentum containing a good amount of fat and an excellent blood supply. This small omentum was attached to the lesser curvature and extended from the pylorus to the cardia, not including, however, the entire cardiac portion of the stomach. In shape it was triangular, and its length was almost half that of the circumference of the stomach at the level of the incisura angularis. Figure 1 is a semidiagrammatic sketch. It appears that the omentum was curled up during the roentgenographic examination and produced a constant defect on the lesser curvature (Fig. 2). When found, it was still partly folded up but was straightened out without any difficulty.

The anlage of the stomach as found in the embryo is a minute, spindle-shaped piece of dilated gut, situated slightly cephalic to the yolk stalk. As the embryo enlarges, the dorsal

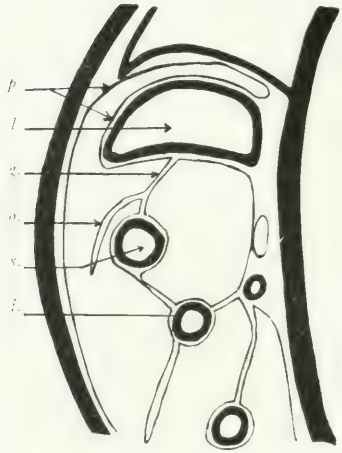

Fig. 8.—Diagram showing position of *p*, peritoneum; *l*, liver; *g*, gastrohepatic omentum; *o*, third omentum; *s*, stomach; and *i*, large intestine.

side of the anlage grows more rapidly than the ventral side, which brings about the formation of the greater and lesser curvatures. The dorsal mesogastrium attaches the greater curvature to the dorsal body wall and the ventral mesogastrium attaches the lesser curvature to the ventral body wall. A ventral mesentery is present only at the cephalic end of the duodenum and is continuous with the ventral mesogastrium. As the position of the stomach changes, the duodenum rotates so as to lie obliquely across the abdominal cavity and finally assumes a nearly transverse position as is found in the adult. Its mesentery fuses with the peritoneum of the dorsal body wall. The ventral mesentery extends only a short distance caudal from the diaphragm. The liver grows into the caudal portion of the diaphragm, and since the ventral mesentery is immediately continuous with the diaphragm in this region, it becomes attached to the under surface of the liver. That is to say, it forms a connecting band between the lesser curvature of the stomach and the liver, and, at the same time, extends for a short distance along the duodenal portion of the intestine. In rotating to the left, the stomach carries with it the ventral mesentery, and this is drawn toward the liver and assumes a position practically at right angles to the sagittal plane of the body. In this position it forms the gastrohepatic and duodenohepatic ligaments, otherwise known as the lesser omentum. In embryos there is found very occasionally an out-pouching of this lesser omentum much like the looping of the great omentum. In the cases here reported, this occasional out-pouching of the lesser omentum was exaggerated to such a degree that when the adult condition of the stomach was attached there apparently was formed a third omentum which hung like an apron over the anterior surface of the stomach.

An anatomical developmental anomaly such as this cannot be of great clinical importance due to its rarity. Roentgenographically, one of them produced a constant defect of the gastric contour on the film which could very easily be mistaken for an ulcer. However, its greatest importance would be at operation where it would have to be differentiated from an inflammatory process.

DEPARTMENT OF TECHNIQUE

ENDOTHERMY, A SURGICAL ADJUNCT IN ACCESSIBLE MALIGNANCY AND PRECANCEROUS CONDITIONS[1]

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IT is my privilege to discuss in this paper endothermy, a treatment of accessible malignancy which greatly reduces the danger of metastasis and the likelihood of recurrence by removing the growth as a necrotic mass instead of as a group of viable cells.

Endothermy is the production of heat in the tissues from within. It is the localized production of heat in response to the many oscillations of the high frequency current, and it is used in surgery for its desiccating or coagulating effect upon the tissues.

The term endothermy has been adopted to identify this particular mode of procedure, and to distinguish its technique from all other forms of cauterization. There is considerable confusion in the terminology of this and other procedures, so that it is today loosely spoken of as the electric needle, the electric cautery, fulguration, diathermy, coagulation, sparking, etc., not one of which names is fully descriptive of endothermy.

I particularly wish to make the point that endothermy is not fulguration; while to say that it is coagulation limits its scope to a small fraction, since for each time we coagulate we desiccate many times. I feel, therefore, that acceptance of the name endothermy, monopolar or bipolar, will result in a needed standardization of the nomenclature of the varied applications of electricity to surgery. Devised and developed by Dr. William L. Clark of Philadelphia, endothermy consists of two different processes, and has, over a period of 15 years, proved of ever-increasing value in the work to which it is applicable.

In the more superficial cases where the lesion is localized and does not extend into the depth of tissues, and where marked destruction is not indicated, monopolar endothermy is used under local anæsthesia, preferably freshly prepared ½ per cent novocaine. The result is desiccation. Its technique is simple. With the monopolar current, a current of high voltage and low amperage, from an Oudin resonator of a high frequency machine, we induce in the tissues just enough heat to cause a localized dehydration. This is accomplished with an ordinary sewing needle held in a suitable handle. With the newer machines we have a fineness of control which allows us to apply the heat where we will, and to what degree we will in all accessible lesions. So delicate is the adjustment it can be throttled down practically to a pin-point area, permitting one to work in the cornea of the eye or on the vocal cords. The method is, therefore, ideal for removing those small tumors of the eyelids which can be taken off at their base without destroying much of the surrounding tissue. It does away with the contracted scar and consequent ectropion.

Endothermy neither chars nor burns, and indeed can be executed through a piece of white paper without marring it. It is this minimum of trauma and slight secondary inflammation which permits the removal of diseased tissue and benign and malignant growths with a superior cosmetic result. This is of particular importance in lesions about the face, neck, and hands. We have in this a refined method for removing those commoner blemishes, which may become malignant, the various kinds of warts, moles, and pigmented nævi. This method has proved of great value also in treating lupus vulgaris, tuberculosis of the cutis, and all forms of tuberculosis of skin and mucous membrane. Vernal catarrh responds to the brushing over of this current, as does leucoplakia. The precancerous dermatoses, including the various forms of keratoses, acanthoma, chronic ulcers, papilloma, fibroma, lupus erythematosus, X-ray dermatitis, and other lesions of the skin and mucous membranes which may become epitheliomatous, as well as epitheliomata themselves, can be removed by endothermy.

It should be remembered that endothermy differs from other methods of cauterization by heat in that the active electrode is cold when

[1] Read by invitation before the American Electrotherapeutic Association, New York, September 19, 1922.

Fig. 1. Case 1. (at left). Rapid growing prickle-cell epithelioma of the floor of the mouth, showing marked areas of induration and crater-like ulceration.

Fig. 2. Case 1. Immediately following one treatment by bipolar endothermy growth was excised as a necrotic mass. Under surface of tongue is adherent to the floor of the mouth. After two years, there is no evidence of recurrence.

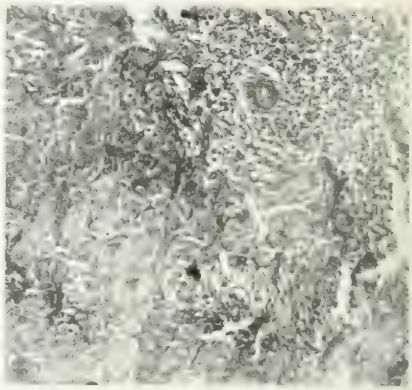


Fig. 3. Case 1. Section showing nests of cells in squamous-cell epithelioma of floor of mouth.

applied. Heat comes from within by the resistance of the tissues to the current. It is, therefore, progressively penetrating according to the amount of current used and the length of time it is applied. This progressive penetration is in contradistinction to heat applied from without, as with the Paquelin cautery, the galvanocautery and fulguration as advocated by de Keating-Hart.

In monopolar work the needle should touch or rather lightly penetrate the lesion to be destroyed, while in treating deep-seated malignancy the needle should be inserted and thrust to whatever depth one desires to carry the destruction. For these deep-seated lesions bipolar endothermy is indicated. Here the heavier and more powerful currents are used and general anæsthesia is advised. Ether is preferable, but must be taken from the room while the current is in actual use.

By means of the d'Arsonval or bipolar current, one of low voltage and high amperage, lesions of larger size and greater depth are given the intense, penetrating action of this endogenous heat. The result is coagulation.

Heat is generated by connecting one pole of the machine to a well-wet, indifferent electrode under the patient's buttocks as he lies upon the table. The other pole, the active electrode, is attached to the handle in which is an ordinary sharp-pointed, steel darning needle of proper length and suitable shape. With this in hand any amount of coagulation necrosis can be described. In the squamous-cell variety of epithelioma and the more malignant and persistent forms of accessible cancer (particularly the lesions in and about the mouth, which metastasize early, are difficult of removal by the knife and are uncertain in their response to physical treatment) endothermy is of the highest value. Lip lesions are removed under local anæsthesia. Any portion of a tongue can be coagulated and immediately cut away. A floor-of-the-mouth cancer can be coagulated *in situ* and the necrotic mass removed in one operation. Bony structure, alveolus, hard palate and portions of the lower jaw likewise can be treated with the same degree of precision.

The following is a typical case of rapid-growing, prickle-cell carcinoma of the floor of the mouth.

Case 1. J. W., age [illegible], sailor, referred by Dr. W. B. Moodie of Valhalla, New York, reported that about [illegible] months previously a pimple had appeared under his tongue. He thought that the dental plate was irritating his mouth, but was assured by his dentist that this was not the case. He paid scant attention to the matter thereafter, but while he was at sea the pimple began to grow. On returning to New York he went to a hospital where "the doctor opened it and since then it has had a hole in it."

Examination showed an indurated mass, about 3 centimeters by [illegible] centimeters, involving the right side of the floor of the mouth. It was tender and had a crater-like ulceration at right of the frenum. It was painful and tender, but no palpable cervical glandular enlargement could be made out. On June 2, 1921, under ether narcosis the entire mass was completely surrounded or isolated by bipolar endothermy. To establish this definite wall of coagulation necrosis around the malignant area, it was necessary in this case to coagulate through the frenum, the under surface of tongue, and the inner surface of right jaw. A section for the mass

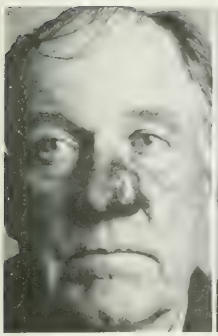


Fig. 4.

Fig. 4.

Fig. 4. Case 2. D. G., age 60, squamous cell epithelioma of nose treated by bipolar endothermy and excised as a necrotic mass.

Fig. 5.

Fig. 6.

Fig. 5. Case 2. Six weeks after operation.
Fig. 6. Case 2. Six months after operation.

scope was then removed with impunity after which the whole mass was coagulated *in situ*. The dead tissue was next removed by scissors and the entire cavity seared over with the current to produce a further penetration of the heat. The lingual artery was not ligated.

Patient returned to room in good condition. Next day there was considerable swelling of tongue and a profuse flow of saliva, but he was free from pain and was able to take liquid nourishment. He left the hospital on the third day in fairly good condition, although toxic absorption had rendered him very cachectic in appearance, with skin of a dark, yellowish hue, both of which conditions cleared up rapidly.

Sloughing of the remaining necrotic tissues began shortly afterward and was complete in the third week, although a piece of bone sequestrated from the inner surface of the jaw in the sixth week. Wound healed completely, and patient has remained free from pain. There was early return to normal diet and a gain of 15 pounds in weight within 3 months. Both sides of patient's neck were treated with deep penetrating X-ray as a postoperative prophylactic measure.

If we consider the technique of the treatment, we shall understand the particular advantages of endothermy. The first step in the procedure is to describe in the healthy tissue a protective ring of destruction around the malignant area. That is, before a malignant area is touched it is completely surrounded by a wall of coagulation necrosis, which shuts off and destroys the blood vessels and lymphatics to and from the affected part. After this the entire lesion is destroyed and removed. Just how much current shall be used and for how long, the operator must learn by experience. Dosage is, however, always under accurate control and conservatism demands that one overtreat rather than undertreat, for a stimulating dose is worse than no dose at all.

It is not difficult to understand that this line of destruction drawn about the malignant area to cut off blood vessels and lymphatics cuts off, also, the sensory nerves, and as the malignancy is removed the pain is alleviated. The value of

Fig. 7. Case 2. One year and six months after operation. No sign of recurrence. Artificial nose made by Mr. O. A. Ilkins, of New York, formerly of Walter Reed Hospital.

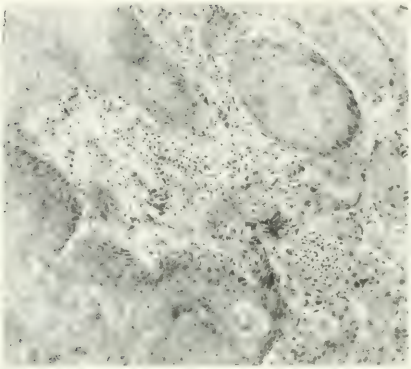


Fig. 8. Case 2. Section of nose case showing infiltrating mass of prickle cells with whorl and pearl formation and inflammatory reaction about them.

endothermy, therefore, in that large group of so-called inoperable carcinoma is very great. Though used in such cases without hope of cure, it provides an alleviation of suffering. In addition, the sterilizing effect of the heat upon a foul, discharging area is appreciated by the patient, for it renders his wound less offensive. One can scarcely overestimate the importance of these features of the method, particularly in the treatment of lesions in and about the mouth. In such cases, the small remaining slough comes away in from 2 to 3 weeks, and the area is completely healed within a few days thereafter. Patient can thus enjoy that early return to normal diet which is of the highest importance, since most of these cases are markedly cachectic, anæmic, and badly run down. Their chief postoperative need is nourishment.

Case 2. D. G., section hand, age 66, referred by patient M. H., reported that about 3 months ago he noticed a small sore on the left side of his nose which rapidly increased in size. His physician applied salves and lotions and finally sent him to a hospital where he had five X-ray treatments. The lesion grew rapidly and became painful. The Wassermann was negative. On November 4, 1921, under complete anæsthesia, the lesion was treated with bipolar endothermy and then excised as a necrotic mass. Convalescence was uninterrupted and photographs indicate the progressive course of nature's filling-in process after the operation.

If the work is properly done there should be no hæmorrhage. Deep penetration beyond the malignant area renders the tissue bloodless. Should by any chance a bleeding point be encountered, it is easily controlled by focussing the current on it for a second or two until the heat is sufficient to stop it. Secondary hæmorrhages do not often occur. However, they have happened in isolated cases and were I to work in close proximity to a large blood vessel I should do a preliminary ligation.

In drawing our conclusions I would remind you that cancer begins as a localized disease and is then curable. The dangers of cancer lie in metastasis and the likelihood of recurrence. By endothermy, a destructive process, we greatly reduce these dangers. Our aim is to destroy, *before excising*, all morbid disease tissue. The intense heat renders the wound sterile and affords nature the opportunity to reproduce her own, by her own constructive, healing processes. These processes will, after treatment by endothermy, accomplish their results in less time, and with infinitely less suffering than characterize convalescence after the use of other physical measures.

TECHNIQUE OF ENLARGED PYELOTOMY FOR RENAL CALCULI

By DANIEL N. EISENDRATH, A.B., M.D., F.A.C.S., Chicago

THE majority of urologists prefer pyelotomy to the classical nephrotomy because of the late complications, such as hæmorrhage, which may follow such a nephrotomy.

Concomitant with this more widespread application of pyelotomy in the removal of calculi, the need has been felt of a larger opening in the renal pelvis than one obtains through the ordinary pyelotomy incision (Fig. 1).

There is some difference of opinion as to who first suggested division of the parenchyma of the kidney at the hilus (posterior aspect) in order to be able to enlarge the incision in the renal pelvis and enable larger calculi to be delivered by this method. It is self-evident that such wider exposure of the intrarenal portion of the pelvis would greatly extend the field of pyelotomy and enable us to deliver calculi by this route which hitherto seemed impossible except by the classical nephrotomy incision, that is, bisection of the kidney.

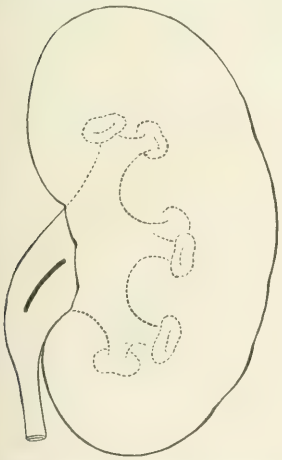
Marwedel is given credit in the German literature for suggesting an extension of the ordinary pyelotomy. In a recent communication[1] Marwedel states that he prefers an anterior pyelotomy in cases of large calculi where it is necessary to prolong the incision into the parenchyma, because the danger of injury to the retropelvic artery is much less. Kelly[2] states that "the ordinary pyelotomy incision can be safely enlarged in an oblique direction (Fig. 2), downward and outward, over the posterior surface of the kidney, and then if necessary combined with nephrotomy (*3–3* in Fig. 2). The oblique incision (*2–2* of Fig. 2) avoids injury to the retropelvic artery."

Marion[3] reports several cases in which he was able to deliver relatively large calculi through an enlarged pyelotomy incision. The direction in which the ordinary pyelotomy is extended into the parenchyma depends upon the long axis of the calculus. He has divided the retropelvic artery in all of these cases without damage to the parenchyma.

[1] Zentralbl. f. Chir., 1920, xlvii, 1034.

[2] Diseases of Kidney, Ureters and Bladder. New York: William Wood and Co. 1914, vol. i, 441.

[3] J d' urol., 1922, xiii, 1.



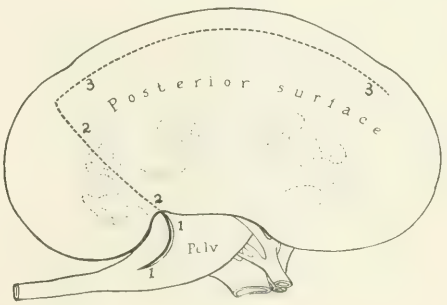


Fig. 1 (at left). Extent of ordinary pyelotomy incision in relation to extrarenal and intrarenal portion of pelvis.

Fig. 2. Extension of ordinary pyelotomy incision (*1–1*) into parenchyma of posterior half of kidney as suggested by Kelly. *2–2* and *3–3* represent the direction of the extension of the incision into the parenchyma of posterior half of the kidney. The oblique incision, *2–2*, avoids injury to retropelvic artery.

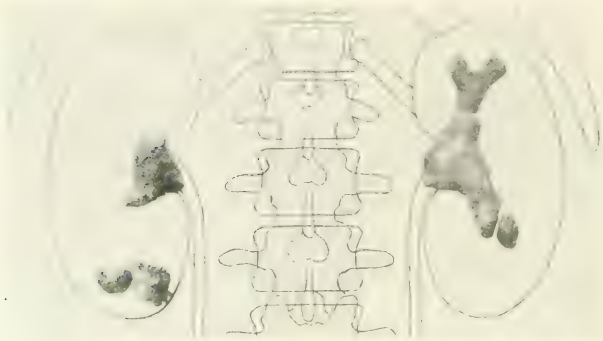


Fig. 3. Bilateral renal calculi. The greater portion (central part) of the left-sided branching calculus (2.5 centimeters by 4.5 centimeters) was removed by enlarged pyelotomy, and the two smaller segments through nephrotomy incisions.

In a recent case I was able to deliver the greater portion (2.5 centimeters by 4.5 centimeters) of a branching calculus (Fig. 3) through an enlarged pyelotomy and the remainder of the calculus through two small nephrotomy incisions. Had I not been afraid to tear the neck of the primary calyces (superior and inferior) it would have been easy to deliver the entire calculus through the enlarged pyelotomy incision.

If the retropelvic artery is doubly ligated and divided, enlarged pyelotomy becomes practically as bloodless as ordinary pyelotomy.

Ligation of the retropelvic artery is not difficult if the overhanging edge of the parenchyma is retracted (Fig. 6) and I feel certain that my suggestion to do this before the pyelotomy incision is enlarged (Fig. 5) will greatly aid the operator by enabling him to work in a bloodless field.

The retropelvic artery (Fig. 4) supplies a comparatively small portion of the parenchyma and ligation at the point suggested (Fig. 6) would even theoretically only involve about one-half of the area indicated in Figure 4. Marion, in the article quoted above, is of the opinion that division of the

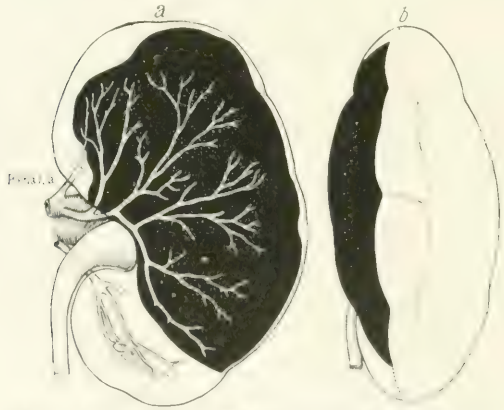


Fig. 4. Area of posterior half of kidney (in black) supplied by retropelvic artery. *a*, Direct posterior view; *b*, from convexity. (After Broedel.)

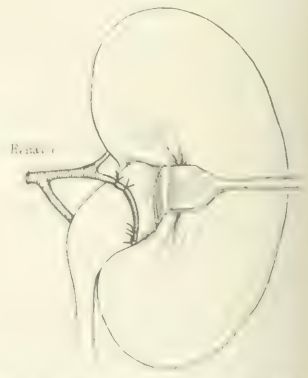


Fig. 5. Parenchyma of kidney held aside during ligation of retroperitoneal artery.

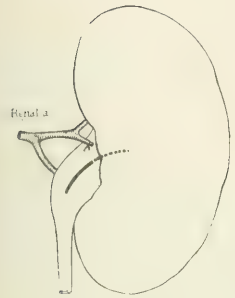


Fig. 6.

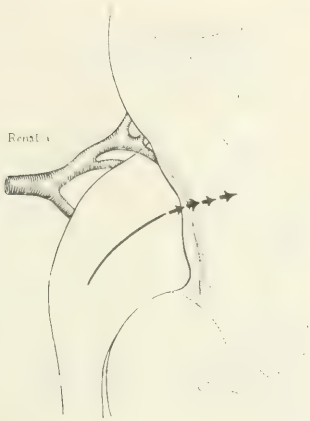


Fig. 7.

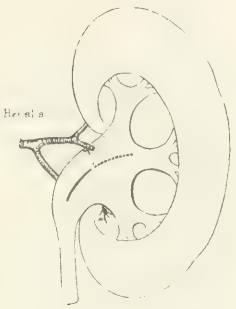


Fig. 8.

Fig. 6. The retropelvic artery has been doubly ligated and divided, thus permitting extension of incision in any direction into the renal parenchyma without hæmorrhage.

Fig. 7. Detailed view of enlarged pyelotomy incision in relation to retropelvic artery and parenchyma at hilus of kidney. Extension of the ordinary pyelotomy incision into the parenchyma indicated by the four arrows. It is understood that incision may be extended in any direction.

Fig. 8. This illustration was made from a specimen in which the parenchyma of the posterior portion of the kidney only with renal pelvis had been removed after double ligation of the retropelvic artery, and removal of the intervening portion. Note how the entire intrarenal portion of the pelvis could be opened by the enlarged pyelotomy incision.

retropelvic artery does not result in any damage to the kidney. From my own experience in the case recently operated upon (Fig. 3), I can endorse this view that the area supplied by the ligated vessel will receive sufficient blood from adjacent arteries which are branches of the system derived from the prepelvic vessels.

The steps of the technique are as follows:

1. If the usual pyelotomy incision (Fig. 1) does not suffice to deliver the calculus, the parenchyma at the hilus is retracted as shown in Figure 5 and the retropelvic artery isolated and doubly ligated.

2. The original pyelotomy incision (Fig. 6) can now be enlarged in any direction which is necessary to enable one to deliver the calculus or to explore the primary calyces.

3. After extraction of the calculus (or calculi), the enlarged pyelotomy incision is closed with interrupted sutures of fine chromic catgut and either the peripelvic fat placed over the suture line or a free transplant of fat taken from the subcutaneous layer of the parietal incision. It is not necessary to approximate the cut edges of the renal parenchyma.

The additional exposure of the intrarenal portion of the pelvis obtained by the above technique can be readily seen in Figures 7 and 8. The former represents a detailed view of the field in enlarged pyelotomy. The retropelvic artery is seen in its relation both to the parenchyma which covers it and to the enlarged pyelotomy incision. Figure 8 was drawn from one of my specimens of a renal pelvis filled with paraffin and demonstrates the additional exposure of the intrarenal portion of the pelvis obtained after ligation of the retropelvic artery and prolongation of the pyelotomy incision into the intrarenal portion of the pelvis. The heavy dotted line represents the direction in which the pyelotomy incision is most frequently extended and the light dotted lines indicate the other directions in which the incision can be extended varying with the long axis of the calculus.

APRON USED IN PERFORMING BOWEL AND STOMACH ANASTOMOSIS

By FRANK H. LAHEY, M.D., F.A.C.S., Boston

THE apron here described has been used by us for considerably over a year, and provides a means of keeping the field quite free from contamination during bowel or stomach anastomosis.

It consists, as seen in the illustration, of two sheets of rubber dam cemented to two pieces of rubber tubing which cover outer blade of each clamp or outer jaws of a three blade clamp.

Figure 1 shows the apron attached to one clamp. Figure 2 shows the aprons attached to both clamps and the method of isolating the anastomosis.

Fig. 1

Fig. 2.

AN IMPROVEMENT ON THE VOORHEES BAG

By EDWARD L. CORNELL, M.D., F.A.C.S., Chicago

IT has always been more or less difficult to determine the amount of cervical dilation following the insertion of a Voorhees bag. To overcome this, Dr. J. B. DeLee and myself have improved the bag by placing rubber ridges around it. The ridges have been placed equidistant from the top of the bag and project just enough to be felt readily on rectal examination. The examining finger follows up the bag from the apex to the cervix and then is carried downward counting the number of ridges which protrude into the vagina. The bag is said to be out one, two, etc., ridges. If all of them can be felt below the cervix, we know the cervix is dilated almost to the full size of the bag. This bag gives a much more accurate idea of the cervical dilation.

Photograph showing ridges on bag.

It was found necessary to place the ridges around the entire bag. The ridges do not interfere with the progress of dilation, nor do they cut the cervix as they are protruded.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
ALLEN B. KANAVEL, M.D. ..... Associate Editor

MAY, 1923

LUNG ABSCESS

RECENT medical literature suggests that lung abscess is a much more frequent condition than it was formerly. This increase is due in part to the fact that many cases owe their origin to the operation of tonsillectomy performed under general anæsthesia, and many more tonsillectomies are probably now being done. It is due also in part to the fact that progress in the use of the X-ray has permitted the exact recognition of many more cases than was formerly possible.

Abscess of the lung constitutes one of the most difficult conditions to treat satisfactorily which occurs in the category of non-malignant affections. The unfortunate victim of pulmonary suppuration may survive the period of danger while the abscess is acute, only to become a chronic invalid subject to frequent attacks of fever, with offensive breath and sputum, and more or less frequently recurring pulmonary hæmorrhages. If he does not die of pulmonary hæmorrhage, he may end his unhappy existence with a brain abscess or meningitis. The ease with which a rib may be resected and an opening made into an adherent lung has made the treatment of lung abscess appear as a simple matter to the uninformed. Fortunately there are some cases which respond to this treatment in a gratifying manner. But there are many others on the contrary which pass into a condition of chronic invalidism even although they have been relieved of a large collection of pus. Any one who follows up his cases operated upon is aware of the full truth of this statement.

If a large abscess is complicated by an empyema, the prognosis at once becomes more grave as regards both life and chronicity. For this reason the use of the aspirating needle is to be avoided unless one is sure of the existence of adhesions, in order to escape the possibility of an infection of the pleura from leakage along the track of the needle. The only safe way in which to use an aspirating needle in searching for pus in a lung abscess is to insert it through an area in which it has already been positively determined that the lung is firmly adherent to the chest wall. Generally this point can be determined only at operation, or by a diagnostic pneumothorax.

Many cases of lung abscess do not require open surgical drainage. Many will make a complete recovery by the use of proper postural drainage. Others will recover satisfactorily with the aid of an artificial pneumothorax. It is difficult at present to define accurately the standards which should determine in any case whether open drainage should be used or some non-operative procedure. In cases associated with a foreign body, it is advisable to remove the foreign body through a bronchoscope if it is readily accessible to removal by this method. After the removal of the foreign body either by the

act of coughing or by the bronchoscope, the abscess should be treated conservatively because usually such cases will heal readily. Conservative treatment should also be tried in all cases of comparatively recent duration in which the patient is not toxic and in which the amount of purulent sputum indicates that a fairly adequate drainage exists through a bronchus. On the other hand, surgical drainage should be performed in all cases of acute abscess in which a reasonable trial of conservative methods has resulted in no progress, and particularly if the patient's general condition has become worse or if the abscess has grown larger. Large abscesses which show a definite fluid level with the X-ray are generally treated more successfully by surgical drainage.

In draining an acute lung abscess, care should be taken to insure the establishment of firm adhesions between the lung and the chest wall. After the subperiosteal removal of a rib the lung can sometimes be seen through the parietal pleura to be gliding up and down with the movements of respiration. Such a lung is not adherent. If any doubt exists it is better to consider the lung as not adherent and to take steps to create adhesions. This can be accomplished by sewing the lung to the parietal pleura or by producing an aseptic inflammation of the unopened parietal pleura by the use of ordinary sterile gauze packing, iodine or iodoform gauze, light scarification with an actual cautery, etc. With any of these methods, at the expiration of from 4 to 8 days the adhesions are sufficiently firm to permit drainage of the abscess without the danger of leakage of pus into the pleural cavity. No anæsthetic is required at the second stage. In other cases it will be of advantage to open the pleura widely at the time of the first operation in order to permit exploration. Lockwood has recently advocated the frequent use of free exploration in these cases to be followed by delivery of the abscess-containing tissue outside of the pleural cavity. Later the whole extrapleural mass is excised. This method would seem attractive for certain cases, but it would seem unapplicable when the abscess is located near the hilus.

An abscess which has become chronic presents a very difficult condition to treat satisfactorily. Here we are no longer confronted with a single cavity containing pus, but instead with a firm mass of induration with often many small abscesses which have become shut off from the main drainage track. The bronchi and bronchioles are often greatly thickened by fibrous tissue, and masses of granulation tissue which bleed easily are often found protruding into the lumina of the bronchi. At other times the whole portion of involved lung may be honeycombed with pus. The patient usually presents a picture of abject misery, with frequent attacks of fever, copious foul sputum, pulmonary hæmorrhages, emaciation, clubbing of the fingers, etc. Drainage in such cases usually accomplishes little, because there is no single cavity to be drained. The establishment of a permanent bronchial fistula will sometimes afford symptomatic relief, but in other cases it will accomplish nothing. Hedblom and Willy Meyer have had some good results with this method. Theoretically, however, the ideal procedure is to remove all the diseased tissue, just as is done in chronic appendicitis or chronic cholecystitis. But the usual operation of lobectomy is accompanied by a very high mortality; notwithstanding this fact, Lilienthal and others strongly advocate it in selected cases. In an attempt to avoid the high mortality of the ordinary lobectomy in these cases, I have recently tried burning out the whole portion of involved tissue with the actual cautery after freely exposing it. The procedure amounts almost to a lobectomy

performed with the cautery. The great advantage over the usual lobectomy is that it is not necessary to separate the adherent lung from the chest wall and thereby expose the pleural cavity to infection. In the few cases in which I have tried it, the procedure has not only been well tolerated but it has given gratifying results. The danger of late hæmorrhage exists but so far I have not encountered it.

EVARTS A. GRAHAM.

THE RELATION OF THE CLINIC TO THE LABORATORY

IN the development of any new thing it is the usual practice to overemphasize its value. The presentation of the claims of the laboratory has undergone this tendency. This was deemed necessary in order to impress the clinician with its importance. The young man does not need such an emphatic introduction. He has taken to it naturally just as most students are attracted to those subjects which they acquire with the least effort. The laboratory appeals to him because it appears as being something tangible and definite, while the term "clinical experience" is something offensive because it is intangible and seems a reflection on his immaturity; something withheld from him by the nature of things, at least for the time being. He has an inward feeling that the laboratory will enable him to beat the game; something which shall substitute for clinical observation. If he can find the tubercle bacillus in the sputum it makes no difference whether or not he is an expert in physical diagnosis. He fails to appreciate the negative side of the problem. To him the search for a specific organism which he fails to find is evidence that such a disease is not present. Curiously enough here the young man meets a common ground with the old clinical man. He, too, fails to appreciate the difference between positive and negative evidence and is quite as apt to stress negative evidence. Worst of all, the clinical man gives little heed to the ability of the laboratory man, and the young man fails to grasp the fact that the finer points in laboratory technique are not acquired in a day. There is no factor more apt to lead to error than an insufficiently prepared laboratory man or a surgeon who cannot foretell with reasonable certainty what the laboratory will show. The laboratory should be regarded as a place where specific questions may be passed on, seldom for the determination of a final diagnosis. It is not belittling the laboratory man to insist that his department is but one leg of the tripod upon which the diagnosis must rest. The other legs are the history obtained by the surgeon and the physical findings revealed at the examination. Sometimes the one, sometimes the other, is the most important. The laboratory findings may be positive, the clinical history may be typical, and the physical findings may leave no question as to the nature of the disease. It must be ever remembered that a tripod is of no use unless it carries something. In this simile it must be the surgeon's brains that surmounts this tripod; the clinical judgment of the surgeon, the intangible something.

To make use of the evidence the surgeon must know the limitations as well as the positive factors of the laboratory. This knowledge can be acquired only by personal contact with the laboratory. This knowledge can be acquired only by long contact, just as history and physical findings can be appreciated only by prolonged personal clinical experience. To paraphase a well-known remark of the distinguished Fenger, the laboratory will not assume its proper place in surgical practice until surgeons "tread a path between the clinic and the laboratory and from the laboratory to the clinic." ARTHUR E. HERTZLER.

MASTER SURGEONS OF AMERICA

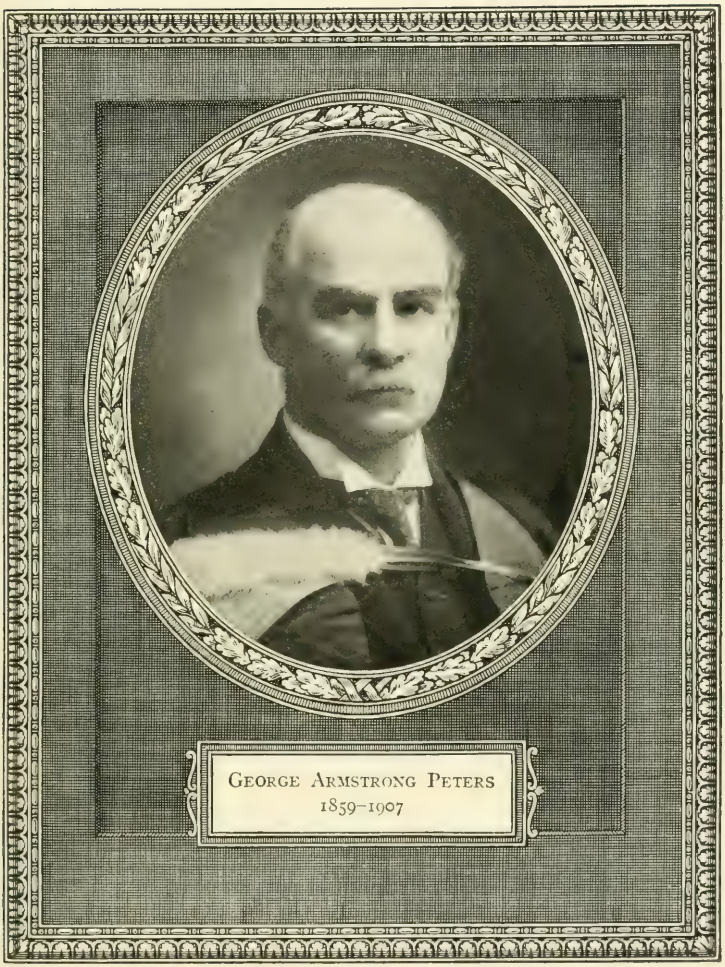
GEORGE ARMSTRONG PETERS

IN the death of Dr. George Armstrong Peters, in the prime of life, and at the zenith of his professional career, Canada lost one of her most brilliant surgeons, and one of the very best of her clinical teachers. George Peters had the very fortunate fate to be born of sturdy yeomanry parents in a country section. It is to be noted that he is one of many professional men in this young country who have worked their way to eminence with the wonderful heritage derived from this simple life, together with a high ambition, indomitable courage, and a willingness to work.

He had a good high school education, matriculated at the University of Toronto and entered the study of medicine in the old Toronto School of Medicine, graduating from the University of Toronto in 1886 with honors, winning the Gold Medal of the University and the Starr Gold Medal of that year. He was an interne in the Toronto General Hospital for one year, and afterward appointed demonstrator of anatomy, University of Toronto. Then followed a very short period of study in England, where he successfully passed the examinations of the Royal College of Surgeons and had the distinction of being the first Fellow of the Royal College of Surgeons in Canada. On his return he was appointed associate professor of surgery and clinical surgery, and after a most efficient service of eleven years, he was appointed professor of surgery and clinical surgery, a post which he filled with great distinction until his death.

Socially he was "an easy man to meet." He was genial and straightforward in his nature, and would not tolerate deceit or hypocrisy in his companions.

Professionally he was a master in his own work, of sterling character and rugged honesty, and fearless in his condemnation of whatever was unworthy of the highest traditions of the profession. As a surgeon he was distinguished for a combination of qualities which easily placed him in the first rank of Canadian surgeons and enabled him to take his place on an equality with the best in the profession the world over. He brought to each case a knowledge and ability gained by study, observation, and research which made him a keen and safe diagnostician. His mechanical ability and ingenuity combined with his artistic temperament made him a surgeon perfect in technique. He had developed very highly also the surgical instinct which is possessed by those who are born for the



GEORGE ARMSTRONG PETERS
1859–1907

task. These same characteristics showed to advantage especially in the plastic types of operation, and in his results in hare-lip and cleft palate he excelled all of his colleagues. He perfected many technical points in operative procedure which were never published, and are known and practised only among his immediate colleagues, or handed on personally through the same channel. It is a source of regret to many of his students that no permanent memorial volume was prepared when his memory was still green, and the touch of his spirit still upon us, so as to preserve for surgery generally, the valuable ideas known to so few. Certainly it is not known generally that the inflamed abdomen transmits both breath and heart sounds very clearly to the lowest part of the abdomen, quite to the symphysis.[1] Quite recently this point has been rediscovered, as noted in *Zentralblatt fuer Chirurgie*, Leipzig, where Hoefer recounts that the pulse is audible over the entire abdomen in cases of intestinal obstruction.

Many new devices, on the other hand, were published, notably his "New Operation for Procidentia," "The Extra-Peritoneal Transplantation of the Ureters for Ectopia Vesicæ," "A New Wrench for the Correction of Stubborn Deformities," "A New and Original Method of Making Casts," and "A New Method of Cutting Urinary Calculi." He also made a fair contribution to the advanced surgical literature of the day which showed his general knowledge of the work of others. He contributed articles on the "Surgery of the Rectum and Anus" to the *International Text Book of Surgery*, by Gould and Warren, and on "Inflammatory Affections of Bone," in Bryant and Buck's *System of Surgery*.

It was probably as a clinical teacher that Peters excelled, and only those who had the opportunity of sitting at his feet know the heritage he was able to transmit to posterity through his students. His clinics were noted for the clear cut and forcible method of expression which characterized his work, and his wealth of illustration and aptitude with chalk fixed on the mind and memory of his students lessons which never will be forgotten.

Peters insisted that every surgeon should have a hobby outside his work, and he practised this doctrine in his own life in several ways. He was an ardent military man, and after a service of some years as lieutenant and afterward as captain in the Governor General's Body Guard, he organized the Toronto Light Horse, and was appointed officer commanding with rank of lieutenant colonel. He was one of the best military riders in the country, and won many prizes for "tent pegging." His mechanical ability showed itself, outside his professional work, in his invention of a wonderfully ingenious, self-registering target for rifle practice, which received the greatest praise both in Canada and in England. He was a lover of horses and always kept a stable of excellent drivers and hunters. He was a member of the Hunt Club and a daring cross country rider.

He died March 13, 1907, at the age of 47, of angina pectoris. Even when he knew the end was approaching, he showed his indomitable courage and his

[1] The telephonic properties of the inflamed abdomen. Canadian J. M. & S., Toronto, 1902, December.

keenness for his professional work by dictating to his stenographer the character of the radiating pains of this dread disease as exemplified in his own case, and showed where they differed from the ordinarily accepted ideas. He was buried with full military honors, and as the "Last Post" sounded over his open grave, all those who mourned the loss of friend and colleague thought of his life rather than his death.

"His life was gentle; and the elements
So mixed in him that Nature might stand up
And say to all the world, 'this was a man!'"

CLARENCE L. STARR.

BOOK REVIEWS

CRITIQUE OF NEW BOOKS IN SURGERY

IT is commonly conceded by the medical profession in America that a chloroform anæsthesia is a very dangerous and treacherous procedure. We hear a great deal of chloroform poisoning, and its rather unique method of destroying life, and yet the large percentage of medical men have no conception of how this takes place.

Until we know more definitely the peculiar action of chloroform, we are in no position to improve the technique of its administration or to recommend that it be entirely dropped from ordinary usage. It is consequently very interesting to read the little monograph of Levy.[1] In this small volume is incorporated a tremendous amount of information, not only on the physical properties, pharmacology, and toxicology, of chloroform but on its peculiar action upon the essential structures of the body.

It has been the author's privilege to have administered many anæsthetics, and he has had the facility of observing the action of these various administrations. This, associated with a rather extensive study from the pharmacologist's point of view and animal experimentation, places him in a position to give us much valuable information. It might be of interest to state that the average death which occurs during a chloroform administration is not produced by the introduction of chloroform or what might be called chloroform poisoning. Most of these deaths take place at the very beginning of the anæsthesia or when it is withdrawn and are due to ventricular fibrillation.

The average medical man's conception of chloroform poisoning is that there is a sudden cessation of the heart's action, and that this is very soon followed by respiratory paralysis. The fact is that chloroform poisoning paralyzes the respiratory centers while the heart is still active. The misconception takes place by virtue of the fact that the average death is not brought about by chloroform poisoning, but as stated above, by ventricular fibrillation.

It is a generally conceded fact that the mortality in chloroform administration is about one in three thousand administrations. The author states that in a list of 13,393 chloroform administrations given by the anæsthetists of the British Medical Association, there were eighteen deaths. At least ten of these were due to chloroform, giving a mortality of one in 1,339 cases. This is still more striking when the fact is considered that these anæsthetics were all administered by experts. Such evidence would make one feel that chloroform in the hands of a novice is an extremely dangerous drug, and that this type of anæsthesia should be used but seldom, and then only by some one not only skilled in the administration of chloroform, but in noting the early signs of disaster.

The author describes several methods of chloroform administration in detail. The outstanding facts gleaned from this is that chloroform should be given very carefully, and that when the administration is once started it should not be withdrawn unless evidences of poisoning are manifest, or until the patient reaches surgical anæsthesia.

This little volume is indeed a very welcome addition to our literature, and for those men who still insist upon using chloroform as an anæsthetic, and who must of necessity have a considerable relative mortality, it is an invaluable contribution. J. A. W.

A SECOND edition of this volume[2] on wounds of the chest speaks for its authoritative popularity. In his introduction the author acknowledges the experience in these wounds gained during the world war and calls attention to their gravity inasmuch as the chest contains the organs so necessary for life. The succeeding chapters are well divided in subject, starting with a general discussion of wounds caused by different types of arms, then taking up chest wounds from both statistical and pathological standpoints. Non-penetrating and penetrating chest wounds of the pleura and lung are described in orderly sequence. Late complications and delayed symptoms are given much attention. Then follows an excellent chapter on wounds of the pericardium and heart. The last four chapters cover wounds of the great vessels, œsophagus, mediastinum, and complications involving the abdominal cavity. KELLOGG SPEED.

THIS small book,[3] 192 pages, covers briefly the use of local anæsthesia in orthopedics and the surgery of childhood. Choice of anæsthetic, indication and methods of use for the whole body are described. The illustrations are diagrammatic and are plainly of help. The volume is a plea for the use of novostasin in all surgery of childhood. KELLOGG SPEED.

[1] CHLOROFORM ANÆSTHESIA. By A. Goodman Levy, M.D., M.R.C.P. With Foreword by Arthur R. Cushny, M.D., LL.D., F.R.S. New York: William Wood & Co., 1922.

[2] FERITE DEL TORACE. By Dott. Prof. Felice Rossi. 2d. ed. Bologna: Licinio Cappelli, 1922.

[3] L'ANESTESIA LOCALE IN CHIRURGIA INFANTILE E IN ORTOPEDIA. By Dr. Oreste Nizzoli. Bologna: Licinio Cappelli, 1922.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

NURSERY GUIDE FOR MOTHERS AND NURSES. By Louis W. Sauer, M.A., M.D. St. Louis: C. V. Mosby Company, 1923.

CHIRURGIE DU MEMBRE INFERIEUR. 5th ed. revised. By Georges Labey and Jacques Leveuf. Paris: Masson et Cie., 1923.

THE PATHOLOGICAL PHYSIOLOGY OF SURGICAL DISEASES. By Prof. Dr. Franz Rost. Authorized translation by Stanley P. Reimann, M.D. With a Foreword by John B. Deaver, M.D., LL.D., Sc.D., F.A.C.S. Philadelphia: P. Blakiston's Son & Company, 1923.

LEHRBUCH DER GEBURTSHILFE. By Prof. Dr. Rud. Th. v. Jaschke and Prof. Dr. O. Pankow. 2nd and 3rd ed. Berlin: Julius Springer, 1923.

TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION. Vol. xi. Edited by Dr. John H. Jopson, M.D. Philadelphia: William J. Dornan, 1922.

THE PATIENT'S VIEW POINT. By Dr. Paluel J. Flagg. Milwaukee: The Bruce Publishing Co., 1923.

LES TUMEURS DU CERVEAU. By C. E. Locke, Jr., M.D. Paris: Louis Arnette, 1922.

LA RADIOTHÉRAPIE PROFONDE. By Dr. Iser Solomon. Paris: Masson et Cie, 1923.

ENLARGEMENT OF THE PROSTATE. By John B. Deaver, M.D., LL.D., Sc.D., F.A.C.S. 2nd ed. Philadelphia: P. Blakiston's Son & Co., 1922.

THE SURGICAL DISEASES OF CHILDREN. By Frederick C. Pybus, M.S., F.R.C.S. Philadelphia: P. Blakiston's Son & Co., 1922.

DIE KNOCHENBRUECHE UND IHRE BEHANDLUNG. Ein Lehrbuch fuer Studierende und Aerzte. Vol. ii. By Dr. Med. Hermann Matti. Berlin: Julius Springer, 1922.

A MANUAL OF GYNECOLOGY. 2d ed. By John Osborn Polak, M.Sc., M.D., F.A.C.S. Philadelphia and New York: Lea & Febiger, 1922.

PREMATURE AND CONGENITALLY DISEASED INFANTS. By Julius H. Hess, M.D. Philadelphia and New York. Lea & Febiger, 1922.

THYROID AND THYMUS. By André Crotti, M.D., F.A.C.S., LL.D. Philadelphia and New York: Lea & Febiger, 1922.

GETTING READY TO BE A MOTHER. A Little Book of Information and Advice for the Young Woman Who is Looking Forward to Motherhood. By Carolyn Conant Van Blarcom, R. N., with an introduction by J. Clifton Edgar, M.D., and Frederick W. Rice, M.D. New York: The Macmillan Company, 1922.

GENERAL AND PROFESSIONAL BIOLOGY WITH SPECIAL REFERENCE TO MAN. By Edward J. Menge, Ph.D. Milwaukee: The Bruce Publishing Company, 1922.

THE PRACTICE OF SURGERY. 3d ed. By Russell Howard, C.B.E., M.S. (Lond.), F.R.C.S. (Eng.). Philadelphia: J. B. Lippincott Company, 1922.

A MANUAL OF DISEASES OF THE NOSE AND THROAT. 6th ed. rev. By Cornelius G. Coakley, A.M., M.D., F.A.C.S. Philadelphia and New York: Lea & Febiger, 1922.

MINOR SURGERY INCLUDING BANDAGING. 9th ed. rev. By Henry R. Wharton, M.D. Philadelphia and New York: Lea & Febiger, 1922.

DISEASES OF THE EAR, NOSE AND THROAT; Medical and Surgical. 6th ed. rev. By Wendell Christopher Phillips, M.D. Philadelphia: F. A. Davis Company, 1922.

ORTHOPEDIC SURGERY. By Sir Robert Jones, K.B.E., C.B., and Robert W. Lovett, M.D., F.A.C.S. New York: William Wood and Company, 1923.

NUTRITION OF MOTHER AND CHILD. By C. Ulysses Moore, M.D., M.Sc. Philadelphia: J. B. Lippincott Company, 1923.

DIE PATHOLOGISCH-ANATOMISCHEN GRUNDLAGEN DER FRAUENKRANKHEITEN. By Prof. Dr. Wilhelm Lahm. Dresden and Leipzig: Theodor Steinkopff, 1923.

DIE BEHANDLUNG DER HAUT-UND GESCHLECHTSKRANKHEITEN MIT KURZER DIAGNOSTIK. By Dr. Erich Hoffmann. Bonn: A. Marcus & E. Webers, 1923.

A MANUAL OF SURGICAL ANATOMY. 2nd ed. By Lewis Beesly, F.R.C.S., (Edin.), and T. B. Johnston, M.D., Ch.B. New York: William Wood & Company, 1923.

ANÆSTHETICS AND THEIR ADMINISTRATION. 5th ed. By Sir Frederic W. Hewitt, M.V.O., M.A., M.D., edited by Henry Robinson, M.A., M.D., B.Ch. London and New York: Oxford University Press, 1922.

ESSENTIALS OF SURGERY; a Textbook of Surgery. 2d ed. rev. By Archibald Leete McDonald, M.D. Philadelphia and London: J. B. Lippincott Co., 1923.

HOW WE RESIST DISEASE. By Jean Broadhurst, Ph.D. Philadelphia and London: J. B. Lippincott Co., 1923.

OPTICAL METHODS IN CONTROL AND RESEARCH LABORATORIES. Vol. I (2d ed., January, 1923). By J. N. Goldsmith, Ph.D., M.Sc., F.I.C.; S. Judd Lewis, D.Sc., B.Sc., F.I.C., PhC., and F. Twyman, F. Inst. P. London: Adam Hilger, Ltd., 1923.

THE NEW PHYSIOLOGY IN SURGICAL AND GENERAL PRACTICE. 5th ed. rev. By A. Rendle Short, M.D., B.S. (Lond.), F.R.C.S. (Eng.) New York: William Wood & Co., 1922.

PRACTICAL ANÆSTHETICS; for the Student and General Practitioner. By Charles F. Hadfield, M.B.E., M.A., M.D. New York: William Wood & Co., 1923.

CHARLES WHITE OF MANCHESTER (1728–1813), and THE ARREST OF PUERPERAL FEVER. By J. George Adami, C.B.E., M.D., F.R.S. London: Hodder & Stoughton, Ltd., 1923.

ÉTUDE RADIOLOGIQUE DES VOIES BILIAIRES NORMALES ET LITHIASIQUES. By Pierre Duval, Gatellier and Henri Béclère. Paris: Masson et Cie, 1922.

MISTAKES AND ACCIDENTS OF SURGERY. By Harold Burrows, C.B.E., M.B., B.S.(Lond.), F.R.C.S. New York: William Wood & Co., 1923.

EINFÜHRUNG IN DIE KLINIK DER INNEREN SEKRETION. By Prof. Dr. G. Peritz. Berlin: S. Karger, 1923.

THE RIDDLE OF THE RHINE. Chemical Strategy in Peace and War. By Victor Lefebure. With a preface by Marshal Foch and an introduction by Field Marshal Sir Henry Wilson (Bart.), New York: E. P. Dutton & Company, 1923.

AMERICAN COLLEGE OF SURGEONS

THE LAYING OF THE CORNER STONE OF THE GORGAS MEMORIAL INSTITUTE OF TROPICAL MEDICINE[1]

By DR. BELISARIO PORRAS, Panama, Panama
President of the Republic of Panama

I experience profound satisfaction from the fact that it is my privilege to lay the corner stone of the Institute of Tropical Medicine which Panama dedicates to William Crawford Gorgas, to perpetuate his memory here, on the shores of the murmuring Pacific and in close proximity to that thoroughfare which—hurriedly in former days as though pursued by the phantom of death and lingeringly today as though regretting the brevity of time which compels them to forego the delights of our benign and even climate, the beauty of our country's unchanging verdure and the incomparable blue of our sky—has been used by men of every nationality for whom Gorgas cherished only sentiments of deep humanity which prevailed always over every prejudice of race, nationality, birth, or class.

This sense of satisfaction that I experience now is derived primarily from the fact that I was a friend of this man to whose memory we are today assembled here to pay tribute, and as such, I was in an admirable position to judge fully the purity of his noble and good heart, and, further, being one of the old men of the days when he lived in our midst, I am better able to appreciate more fully than the men of the younger generation, the great work of health, life, and happiness which this great man accomplished for my country.

The monument which we will erect here will be an expression of Panama's gratitude to the man who proved beyond the peradventure of a doubt that the tropics could be made habitable for all the races of the earth. We are indebted to the genius of Gorgas for the transformation of Panama from a fever-ridden land to the paradise we now live in. Therefore, we consider that Gorgas to a certain extent belongs to us also, because it was here he saw his great effort to lighten the burden of suffering humanity, crowned with success.

It is the privilege of great men, sages, discoverers, heroes and martyrs, whose activities, teachings, and examples are not circumscribed to the narrow confines of the land of their birth and whose achievements in the world have been beneficial to the majority if not to all their fellow-beings, to be universally loved. Such men—and Gorgas was one of them—cannot be citizens of one particular city, town, or village, for every city and every nation of the earth claims them; they are the real citizens of the world.

As in the case of Æsculapius, when it was found necessary to enlist the services of an oracle to determine in which of the cities of ancient Greece which disputed this honor, was his birthplace, and, as in the case of Christopher Columbus, who has been declared an Italian, a Spaniard and more recently a Jew, the birthplace of Gorgas, I am informed, is disputed, both Alabama and Georgia claiming this honor. However, Gorgas does not belong exclusively to the United States of North America where he was educated. Cuba and Serbia, Bulgaria and Ecuador, Panama and South Africa, all have claims to him as a result of his having lived and worked among them for the good of the human family.

The work accomplished in the world by the great Gorgas is immense, immeasurable. Of Hippocrates it may be said that he was the first to divorce medicine from witchcraft and the ecclesiastical mysticism of his times; of Galen, that he was a great physician and writer to whom is attributed the authorship of about 500 books intended to popularize the practice of medicine; of the great Pasteur, de Kock, Ramon Cajal y Cajal, Elhricj, Finley and Rose, that they penetrated far into the hidden secrets of the invisible, the infinitesimal world; of Metchnikoff that he evolved the famous phagocyte theory and with Roux, Chamberland, and Calmette, collaborated in and continued the work of the great Pasteur; but how can we describe Gorgas, who solved the apparently impossible problem of making the tropics habitable, thus complementing the marvellous work of God Who created us in order that we might live on this terrestrial globe and be happy on it? Gorgas destroyed the morasses of

[1] Address delivered at the laying of the corner stone of the Institute, February 18, 1926, at Panama, Panama.

death and gave us pure drinking water and purified the air of our exuberant tropical forests and our colonial cities. Gorgas redeemed the tropics.

I can still remember, and it seems to me a horrible nightmare, the time, 50 years ago when, on my way to Bogota to finish my studies I found it necessary to spend a night in Colon. Sleep during that night was impossible for me because of the constant and tormenting bites of the mosquitoes, the incessant buzzing of which smote on my ears as though they were the discordant notes of an infernal serenade. These minute tormentors were so numerous that by clutching at the apparently empty air I caught handful after handful of these tormenting pests. Neither can I forget conditions as they prevailed when I returned from college ten years later and entered the employ of the French Canal Company. From that time I was able to realize or at least suspect the underlying cause of the Frenchmen's failure in their attempt to construct the trans-Isthmian waterway. They constructed beautiful residences and tree-lined avenues and admirably organized their offices; but they did nothing, in fact they knew nothing, about tropical sanitation and apparently never suspected its worth.

In those days of long-ago, it was the most natural thing for one to promenade the city's thoroughfares holding a handkerchief to one's nostrils, to keep out or lessen the stench contaminating the air as a result of decaying vegetation, stagnant or putrid puddles and primitive or defective sewerage. On every hand one encountered well-beloved friends hastening home in the grip of malarial chills or some other equally pernicious fever; or encountered on every street, people clothed in the somber black garb of mourning with the marks of grief and despair deeply impressed on their features; or daily heard the lugubrious tolling of church bells announcing the death of a friend or a relative; or was frequently summoned to attend the last rites of a departed friend laid low by the deadly miasmas of our unsanitary tropical homeland.

However, thanks to William Crawford Gorgas, these days have passed never to return and our tropical home has become one of the world's health resorts.

In the days of ancient Greece, shrines and temples were erected in the mountains and at the Springs of Health in honor of Æsculapius, the God of Medicine. To these places of worship and thanksgiving an endless stream of sick and afflicted persons came to offer sacrifices and deposit votive tablets on his altars. And it is a temple such as these that we will erect here as a living testimonial to the memory of the man who brought so much comfort to the Isthmian family and the tropical world in general.

On this first stone, there will arise a great temple dedicated to this great man, and to this shrine of Gorgas will come in a never-ceasing pilgrimage, not only our sick compatriots but also the afflicted thousands from other points of the tropics to seek health with undying faith in the name of Gorgas. And they will depart hence for their distant homes, healed and happy, with tears of gratitude in their eyes and blessing our beloved country and the great and humane work of William Crawford Gorgas, the benefactor of humanity and the redeemer of the Tropical World.

THE PURPOSE OF THE INSTITUTE

By AUGUSTO S. BOYD, M.D., F.A.C.S. (Hon.), Panama, Panama

THE medical body of Panama accompanied by a select delegation of the most eminent surgeons of the United States of North America, are assembled today to witness the founding of a temple of science, in which will gather the men of science from all the races of the world to work in unison and for the sole purpose of finding relief for humanity's ills through the eradication of the many diseases which afflict mankind.

Nothing more logical than that Panama, filled with gratitude for the immense services rendered her children by that illustrious North American, William Crawford Gorgas—on initiating and carrying out the establishment here of an Institute for Research in tropical diseases—should have selected his name as the most fitting by which this institute should be known; because, the transformation recorded in the salubrity of our country and the happy termination of that great undertaking *pro mundi beneficio* are worthy fruits of his admirable application of the principles of modern hygiene, which though already known, required for their successful application a great organizing head extremely careful of details.

Therefore, our chief executive, His Excellency President Belisario Porras, on suggesting the creation in our country of an institute similar to

the Rockefeller Foundation, with altruistic aims and for the benefit not only of the Americans but of the entire tropical world, happily decided that said institute should bear the name of the famous hygienist and benefactor of Panama, and this suggestion was well received everywhere and the project is now a fact with the by-laws of the institution duly registered in the State of Delaware of the United States of North America and here in our country.

The Gorgas Institute is presided over by a Board of Directors of which Rear Admiral William C. Braisted is the head, and a board of scientific directors over which presides a no less illustrious personage, Dr. Richard P. Strong. The collaborators in the practical and theoretical work of the institute will be selected from among the most important international schools and institutions in France, Great Britain, Japan, the United States and South America. This institution will also open a greater field to our doctors, where, on proving its competency and passing the required test, the merits of the Panamanian brain may victoriously conquer the laurels of the savant, offer to humanity the fruits of its efforts and add to the luster of the nation's good name, as is the duty of every good citizen. And I take advantage of this opportunity to urge you all, especially those of the younger generation which is now coming up, to undertake the study of our science with all your might and determination, undergoing all the sacrifices demanded by work of this nature, confident that when you have reached the goal you will be amply compensated with the eternal gratitude of your countrymen and that of the entire world.

As an example of this, I may cite the career of the eminent American hygienist, very worthy of emulation, to whom we are paying tribute today, perpetuating his memory with the dedication of an institute which will bear his name, a name which will ever be heard with the respectful veneration as is its due.

Many of those gathered here today are aware of the arduous struggles which attended the early attempts of the disciples of the great de Lesseps, whose collaborators were decimated by the cruel diseases of that time against which medical science made heroic but useless efforts, as occurs when unknown obstacles are encountered. Of 100,000 men who worked in the excavation of the Canal during a period of nine years, the death rate reached the enormous total of 22,000 men. Malaria placed its deadly touch on the most beloved members of our families—the bloodless, apathethic and exhausted semblances of our dear brothers and children who entered the zones of labor to return home sick and disheartened, some of them only to breathe their last in the midst of their loved ones, is so recent an experience that it must undoubtedly be still fresh in our memories. Our tender babes succumbed quickest to attacks of the pernicious fever in those days when physicians had to travel around with the hypodermic ready to administer the quinine injection.

With what pride and what satisfaction we can say today: "All this has disappeared now!" And to whom do we owe this?

To that illustrious and good friend, the indefatigable Gorgas.

Intimately connected with the Gorgas Institute will be our new Santo Thomas Hospital. Once again we of the medical profession must voice our gratitude to the progressive citizen who directs the destinies of our Republic. His Excellency Dr. Belisario Porras, in his efforts to equip the Republic with a hospital for his fellow citizens, modern in architecture and in equipment, has considered nothing too good for the relief of his afflicted countrymen, regardless of creed or color.

The expense which the construction of this new hospital entails for our treasury can never be considered excessive if we take into account the fact that it is for us all and for our posterity. I feel safe in asserting that our work will be at least twenty per cent more efficient than it is at present, once we begin working under these new conditions. What today might seem to the uninitiated a needless luxury, will later on be regarded as a godsend, a blessing.

Modern hospitals which are equipped with all the advantages which hygiene and science offer have, as their fundamental basis, microscopic cleanliness and other details of ventilation, lighting and sewerage which are costly in their installation, especially as regards operation rooms and maternity wards, which must be free of every element which might make infections possible.

I, as a physician, and you as the parties benefited in your health, can do nothing less than applaud the undertaking and support it in order to accelerate its early termination and be able to enjoy its benefits at the earliest possible moment.

In conclusion you will permit me to voice our welcome and gratitude to our visitors, my honorable colleagues, for their participation with us in these ceremonies.

Fellow colleagues of the American College of Surgeons:—In behalf of the Government, the people and the medical profession of Panama, let me welcome you to our midst, thanking you

for honoring with your presence our festivities of the day, inaugurating the work of construction of the Gorgas Memorial Institute.

The name of Gorgas is cherished by all Panamanians as that of a public benefactor, and as a means of showing our gratitude for the great work he has accomplished in our midst, we have honored our future Institute of Research by giving it his name as he must live in our history side by side with our great men.

After terminating your trip to the southern sister republics, where we are sure you will find a no less hearty welcome than in Panama, and when you are once again in your respective homes, we hope that you will bring to mind fond recollections of this day and do what your weighty prestige can toward favoring this work, so that the Institute will have the character and scope hoped for.

Wishing you *bon voyage*, we would like to impress upon you that our medical institutions, present and future, are open to you all; here you will be gladly welcomed and the co-operation of your wisdom invited and highly appreciated.

RESPONSE TO TRIBUTE TO GORGAS

By FRANKLIN H. MARTIN, M.D., Chicago
Acting President, Gorgas Memorial Institute for Tropical and Preventive Medicine; Director-General, American College of Surgeons

IT is fitting that we, surgeons from Canada and from the United States, many of whom served in the uniform of our chief, traveling to pay our respects to the Central and South American countries, should assemble with our families and yours in this garden paradise to honor the memory of William Crawford Gorgas, whose genius brought to it its worth, its beauty, and its charm.

Gorgas, simple in character, a lover of men, with a vision of the fundamentals of the intricate discoveries of science, by the simple application of a formula conceived by him, wrought a miracle that for all time will enrich the world, as Lister revolutionized surgical progress from the discoveries of Pasteur, and as the lowly Nazarene brought forth from the wisdom of the prophets his pronouncement that Christianized the world.

We, assembled here, are the apostles of Gorgas, brought together by our mutual admiration for him, to build on this place a monument that will be to us and to all people a symbol of his greatness, and that will enable his devoted followers to continue his work as he himself would have desired. It cannot add one iota to the monument that he created in his modest way, by his honest character, his gentle persistency, his unostentatious industry, and his enduring patience.

For, in one century, in ten centuries, or in twenty centuries it will be known that it was in this little country, between two seas, that he went about and did his work, and citizens of great commonwealths of the future, on the Orinoco, on the Amazon, on the Ganges, and in all the tropics of the earth will tell how Gorgas was their savior; how he brought to them a physical blessing that transformed their regions from the lands of death to the living communities of civilization; and it will be remembered then, in those far off days, that we, his contemporaries, loved him and sought to honor him.

President Porras, you know, and I know, how our friend loved this, his beloved isthmian country, and how, in the evening of his life, when upon him rested the enormous responsibility of presiding over a great corps of the greatest war, in his moments of contemplation, his vision was turned toward Panama, the place which was selected by him to be his final earthly home when retirement should come. And we, here gathered to pay tribute to him, the great benefactor, may be assured, if the screen is not too impenetrable, that around us, in approbation, is his genial presence in spirit, and over us is shed his love and his benediction.

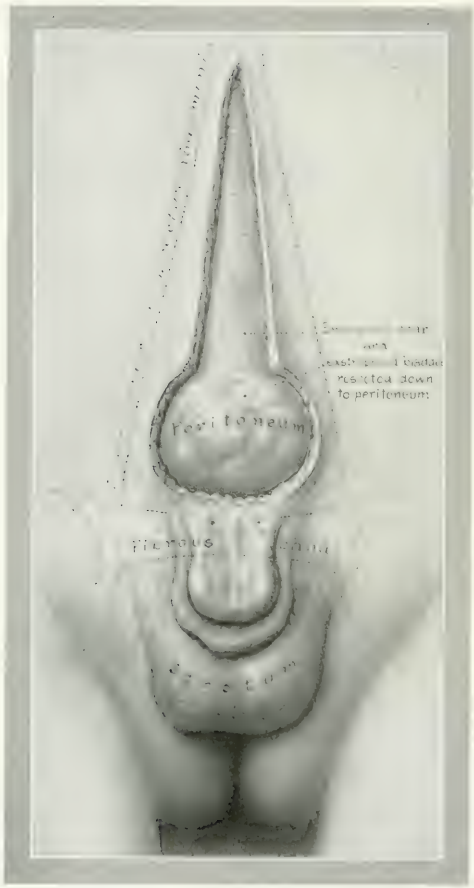


Fig. 9. Excision of rudimentary bladder and scar tissue. Circular area in the lower part of the incision represents the area from which the bladder was removed. The upper portion, the area from which embryonic scar tissue was removed. Dotted lines represent the inner borders of the recti abdominis muscles, and also the fibrous band and ends of rami of the symphysis.

SURGERY, GYNECOLOGY AND OBSTETRICS

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EXSTROPHY OF BLADDER WITH SUCCESSFUL TRANSPLANTATION OF URETERS INTO RECTUM

REPORT OF TWO CASES

BY E. H. HUTCHINS, M.D., F.A.C.S., AND A. F. HUTCHINS, M.D., F.A.C.S., BALTIMORE

IT would be difficult, indeed, to find a more pathetic disease or deformity, with its accompanying disturbance of the generative organs, than that of exstrophy of the bladder. In addition to the physical pain and inconvenience to which he is subjected, if the condition be allowed to remain uncorrected, the victim, a worse than sexless being, is tolerated only as an unwelcome member of society and remains doomed to social and economic isolation.

According to Neudoerfer (1), this abnormality occurs once in 50,000 persons, and according to Spooner (2), who combined the statistics of Henow, Sickel and Winckel, four times in 116,500 birth records. The ratio in which it occurs in boys and girls is about eight to one. Marion (3), however, has pointed out that nature seems to be kind to sufferers from this deformity, for Berger, according to Orlow (4), states that of 74 children born with exstrophy only 23 passed the twentieth year of life, the others dying of pyelonephritis and other kidney complications.

As to the etiology of this deformity, there are various theories. Bon and Duncan (5) adopted an entirely mechanical view, holding that the deformity is caused by complete rupture of the fetal bladder, from overdistention. Velpeau (6) considered it to be due to ulceration of the abdominal walls and bladder, between the second and third months of intrauterine life, when the tissues are very thin. Vrolik (7) advanced the theory that the deformity arises from an arrest in the development of the bladder and urachus from the fetal allantois. Variation in the specific gravity of the amniotic fluid has been assumed as the cause. These, however, are merely theories, which it would be somewhat difficult to prove or disprove.

Defects often associated with this condition are epispadias, in the male; the pubic arch is incomplete anteriorly; the transverse rami of the symphysis pubis may be several inches apart; the umbilicus is lower than normally; the pelvis broader, flatter, and the femora turned outward, so that in many cases the patient has a waddling gait. Ventral and inguinal hernias, spina bifida, and harelip are also occasionally found. So far as we have been able to gather, the prostate, the seminal vesicles, and the testicles are always present.

We were unable to find in the records any report of procreation in the male. In the female, Winslow (8) reported the case of a woman who had had four children. Moorehead (9) reported a case in a woman who had borne two children.

The terminal result in exstrophy of the bladder, in untreated cases, as a rule, is death from pyelitis, pyonephrosis, and hydronephrosis.

According to Sweet and Stewart (10), a fact which Sampson thought he had also demonstrated, infection does not extend from the bladder to the kidney along the ureters, but along the lymphatics surrounding the ureters to the kidney pelvis. In support of this view, they cite Sugimura's observations in 21 autopsies that the walls of the lower part of the ureters are nearly always involved in acute cystitis, whereas there is only a slight amount of inflammation in the mucosa.

About 1851, exstrophy of the bladder with its accompanying deformities began to be looked upon differently, and sufferers who had survived childhood were given an opportunity to benefit by surgical interference.

Flagani (11) about this time described a case in a person of 70 years, and later reported two cases in patients 26 and 49 years old, respectively. In 1851, Simon (12) transplanted the ureters into the intestine, and so far as we have been able to learn, this was the first attempt to divert urine into the rectum. The operation proved unsuccessful.

Roux (13), in 1852, developed a plastic operation for the purpose of constructing a bladder on the abdominal wall. Modifications of this method were introduced by Nélaton (14), in 1854. These also were unsuccessful.

The first successful plastic operations for exstrophy were done by Ayres (15) and by Pancoast (16), in 1858. Wood (17), in 1869, reported eight cases. No attempt was made by these surgeons to control the urine, their idea being to form a pouch to which an apparatus could be applied, so that the patient might be saved the humiliation of having his clothes saturated constantly with urine. There are many objections to this method. Several operations are usually necessary even to form a pouch, and all of them expose the patients to great risks. Moreover, it is impossible to keep the pouch clean, because of the pubic hairs and lime deposits.

Trendelenburg (18), made a partial separation of the sacro-iliac joint, and attempted an approximation of the pubic arches over the bladder.

Koenig (19) and others made subcutaneous sections of the bony arches to aid in the development of the bladder. The mortality was about 30 per cent in these cases.

Incontinence is the bugbear of these patients and any method that fails to remedy this defect will never prove successful. From a review of the literature and actual observation, it is quite apparent that the only way to eliminate incontinence is by transplanting the ureters into the intestine either intraperitoneally or extraperitoneally.

Thomas Smith (20), in 1891, transplanted both ureters into the rectum, extraperitoneally. In the same year Kuester (21) did a similar operation after removal of a bladder for cancer. Chaput, in 1892, transplanted one ureter into the rectum for the cure of a ureterovaginal fistula. The patient lived 9 years.

So far as we can find from the literature, Chalot (22) was the first to do a successful bilateral transplantation of the ureters, following removal of the bladder for cancer. This operation was done in 1890.

Reginald Harrison (23), in 1897, showed a patient who had suffered from exstrophy, upon whom he had done a left nephrectomy and transplantation of the right ureter through the loin. On being asked why he had removed one kidney, he replied that it would have been extremely difficult to collect the secretion satisfactorily from both sides.

Numerous other methods have been devised, but the two which have become most popular, and which have given the best results, are ureteral transplantation into the intestine, intraperitoneally or extraperitoneally.

Simon, in 1852, connected the previously closed bladder with the rectum by making a ureterorectal fistula. Fowler (24), in 1898, did the valve type of operation.

Diakonow (25), in 1908, drew a strip of bladder through a space tunnelled between the sphincter ani and the rectal mucosa, so that the anal sphincter closed the new urethra as well as the anus.

Gersuny (26), in 1898, separated a loop of ileum and, after re-establishing the continuity of the intestine, brought one end of the loop down through a tunnel made within the anal ring, and at a second operation transplanted the base of the bladder into the upper end of the short segment of bowel intraperitoneally

Verhoogen (27), in 1908, divided the ascending colon and the ileum near the ileocæcal valve, after which he closed the four ends and completed the intestinal canal by a union of the transverse colon and ileum. The appendix was drawn through a perforation in the abdominal wall and catheters were passed into the opening for irrigating the cæcum. Later the base of the bladder, with the ureter intact, was united with the cæcum and emptied of urine at regular intervals by means of a catheter. Both patients died.

Maydl (28) was the first surgeon to transplant successfully the trigone with ureters intact, intraperitoneally. Moynihan (29) did the same operation, extraperitoneally, in one successful case. Bergenhem (30), in 1894, was the first to succeed in transplanting the ureters into the rectum, extraperitoneally. The two methods go by their names. In America and Great Britain, credit goes to Peters (31), who practiced the procedure and published an account of it without the knowledge of Bergenhem's work. In Italy it is known as Pozza's (32) operation. According to Buchanan (33), the immediate mortality in Maydl's operation is 28.7 per cent. Of 57 patients who recovered, 65 per cent have lived 1 year, 24 per cent over 5 years. To this number, if we add Stevens' list of 16 cases (34), the immediate mortality becomes 28.1 per cent. Of 69 patients who recovered from the operations, 66.7 per cent have lived more than 5 years. Bergenhem's operation consists of an independent extraperitoneal transplantation of the ureters into the rectum with a rosette of bladder wall and removal of the bladder. Figures show a mortality of 11.5 per cent, and with Stevens' figure added to this 15 per cent. Of 28 patients who recovered from the operation, 60.7 per cent have lived over 1 year and 21.4 per cent over 5 years. The Mayo Clinic has probably had a larger number of cases of exstrophy than any other clinic. Their method of operation is as follows: The ureter is divided about 1 inch from the bladder wall, the lower end is ligated and the peritoneum closed. At a point opposite the isolated ureter, an incision is made through the outer coats of the bowel, and at the lower end a puncture is made through the mucosa, large enough to admit the ureter. The ureter is drawn through and fixed. The divided peritoneum and muscle of the intestine are then approximated over the ureter. One ureter is transplanted at the first stage and in about 10 days the second ureter is transplanted. In third stage the bladder is enucleated and the short ends attached to it removed.

Fig. 1. The exstrophy of bladder. There is an absence of umbilicus, the skin over the region of the umbilicus and down to the rudimentary bladder resembling embryonic scar tissue. The darkened area with two openings in the lower portion represents the rudimentary bladder with the ureteral orifices. The ejeculatory ducts and verumontanum may be seen below the rudimentary bladder in the floor of the urethra. One-half of the circumference of penis including roof of urethra, glans, and prepuce is absent. The dotted lines represent the ends of the transverse rami of the symphysis pubis. The scrotum and testicles are normal.

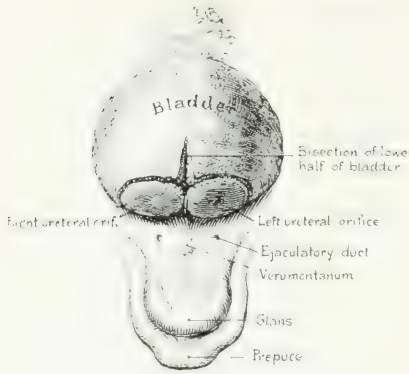


Fig. 2. Herniated rudimentary. Circular incisions showing the section of bladder mucosa with ureteral orifices in the center. Line of incision by which base of bladder was bisected.

In their series of 52 patients, 6 were operated on by the plastic method, one died; 6 months later, 3 were operated on by the Maydl-Moynihan method, two of whom died of uræmia. Twenty-six were operated on by the transplantation method, 22 successfully. Seventeen of the patients examined were not operated on at the time. Some of these were too young, others with diseased or dilated ureters were advised against operation.

Since Stevens' report, the Maydl procedure has been carried out in the following cases:

1. Mugincy's case; patient living.
2. Nové-Josserand's case; patient living 1 year after.
3. Moorehead's case; a man aged 20, died on the seventh day, from peritonitis.
4. Moorehead's case; a woman aged 26, living 1 year after, at the last report.

In the following cases Bergenhem's operation has been carried out since Stevens' report:

1. Coleman's case, a boy of 18 years; operation February 2, 1916, well 2 years later.
2. Mueller's case; female, aged 36, operation in 1917.
3. Holman's case, female, aged 30, operation in March, 1918. Living and well in January, 1920.
4. Joseph Burke's case; female, aged 16; operation June 14, 1920.
5. Authors' case; male, aged 5 years, operation, lived 2 years after operation and died of influenza.
6. Authors' case; male, aged 19, operation November 17, 1919; living and well, October, 1922.

When we consider these two methods and compare them, we find a much higher primary mortality following the Maydl operation. Naturally any method which necessitates opening the peritoneal cavity must tend toward a high mortality, mainly on account of the greater chances for infection, and the greater risk from shock. The extraperitoneal operation, therefore, in our opinion, is the easiest and the safest method of transplanting the ureters in exstrophy of the bladder. With any method, transplantation of the ureters, if it be carefully and properly done, is of necessity a very delicate piece of work, and the dissection must be made in such a way as to cause a minimal amount of trauma, so that the nerve and blood supply to the parts may not be destroyed or materially injured. When the Bergenhem method is employed, the rectum should be carefully cleansed before operation. The ureters should be dissected out far enough so that, when transplanted, they will not be subjected to any degree of tension. Kinks and twists should be carefully avoided.

Case 1. C. K., male, age 5. Except for the congenital exstrophy the family and personal histories have no bearing upon the condition. In spite of remarks by his playmates concerning his wet and smelly clothing, he is neither cowardly nor belligerent. On account of his constantly wet clothing, it has been necessary for him to stay indoors until warm weather returned each spring. As a result of irritation by the urine, he always suffers from a burning in the region of the bladder, perineum, and inner portion of both thighs. He eats well and sleeps well, usually alone. His mother states that she would rather see him dead than go on as he is. Born with a "leaky bladder," he has been burdened continuously with its effects. Otherwise he has been a healthy boy.

Physical examination shows a fairly well nourished, and well developed boy, from the umbilicus up. Instead of showing a normal umbilicus this region of the abdomen is occupied by a triangular area of embryonic scar tissue, with its apex where the umbilicus should be normally and its base cor-

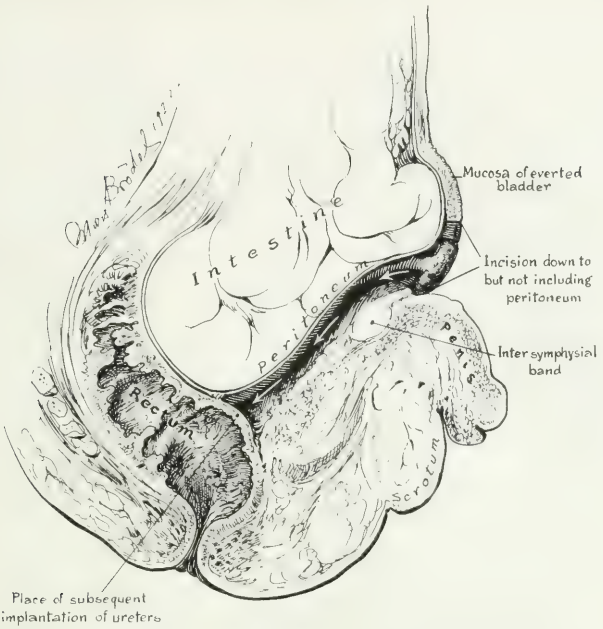


Fig. 3. Dissection of ureter and pushing back of peritoneum. Line of dissection showing peritoneum and exposing anterior wall of rectum and intersymphysial band.

responding to a line normally occupied by the symphysis pubis and its rami. There is a hernial protrusion in this area, which extends from one rectus abdominis muscle to the other. These muscles are apparently normal above the deformity, but from the point normally occupied by the umbilicus downward they diverge, and are attached to that portion of the incomplete pelvic ring which corresponds to the rami of the pubis. The pyriform muscles are apparently absent. In the lower portion of this triangular area there is an area sharply contrasting in appearance with that of the pigmented skin above. This area is fiery red in color, very moist with urine, and covered with a layer of mucus, which is rather tenacious. This is definitely mucous membrane lining the posterior wall and the base of an incomplete bladder. The surrounding skin is red and excoriated. After the surface has been dried carefully with a sponge, the ureters are easily found and intermittent spurts of urine can be seen to escape and run down the thighs.

There is an absence of the symphysis pubis together with portions of the rami. The verumontanum and ejaculatory ducts are plainly visible. There is no roof to the urethra, and the penis looks as though it had been split into equal halves, from end to end, the upper half having been completely removed, the other half remaining undeveloped. The hips are wide, resembling those of a female. There is a very dense band of fibrous tissue in the region usually occupied by the symphysis. Even at the age of six the pelvis is rigid and the boy walks in an erect and graceful manner.

A differential diagnosis between congenital exstrophy of the bladder, acquired exstrophy, and destruction due to infection or malignant disease is not difficult.

In addition to exstrophy of the bladder, he also has a hernia of the abdominal wall occupying the deformed area, diastasis of the recti muscles, congenital absence of part of the tissues in the lower mid-abdominal wall, absence of the symphysis pubis and part of its rami, complete epispadias.

From the standpoint of treatment, the following problems present themselves:

1. To provide storage for the flow of urine where it may be retained for a reasonable time and from which it may be evacuated voluntarily;

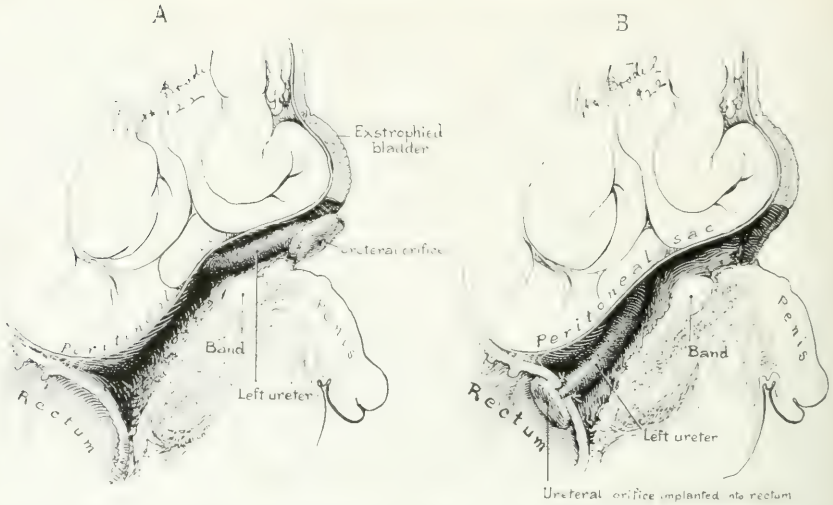
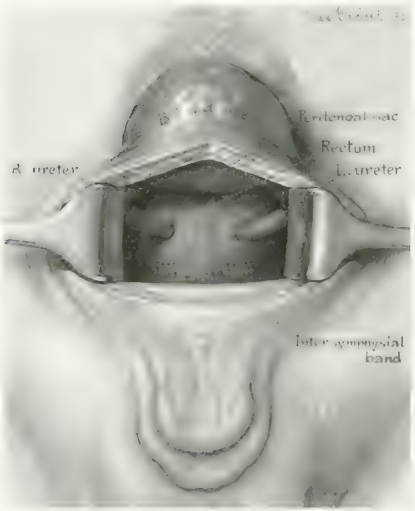


Fig. 4. *A*, Dissected ureter being adjusted. *B*, The ureter inserted into the slit into the rectum, and sutured in place.



[illegible] symphysial band. The transplanted ureters in place with

2. To bring about complete removal of the crippled and conceivably dangerous rudimentary bladder;

3. To cure the hernia by a plastic operation;

4. To bring about restoration of the urethra, while conserving the accessory organs of reproduction;

5. To complete the bony ring of the pubis by means of bone graft, which may be desirable, but is unnecessary if the fibrous band is left uninjured.

Operation May 11, 1917. Under ether anæsthesia the orifices of the ureters were located and ureteral catheters inserted for some 8 to 10 centimeters, care being taken not to allow them to extend farther. Circular incisions were made around each of the ureteral orifices, extending through the bladder wall in such a manner that segments of the two circles were in contact (Fig. 2). This was done to "conserve in so far as possible, the anatomical and physiological relations that obtain in that portion of the bladder wall which the ureters traverse."

While the possibility of conserving the nerve supply to these ureterovesicular structures to our minds is questionable, conservation of the blood supply to the dissected portion of the ureter is a different problem, and is not only desirable but seemingly necessary.

To accomplish this economy of blood supply, care was exercised in dissecting the circular area of the bladder and the ureters, and the bleeding vessels were caught with fine-pointed clamps. We also felt that, in dissecting out the ureters, it was well worth

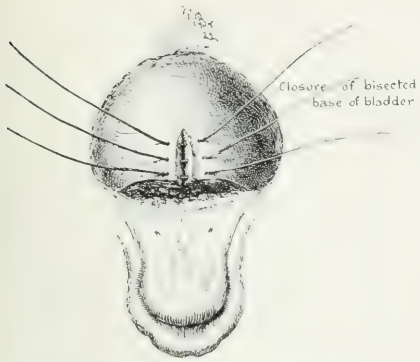


Fig. 6. Closure of partially bisected bladder

while to keep as far away from them as possible, so that they would be practically tucked away from injury, and remain secure in a tube or sheath of mobile tissue. Localization was rendered much easier by means of catheters placed in the ureters. Having, then, conserved the valve-like mechanism about the ureterovesicular orifice and the blood supply and possibly the nerve supply to the ureters so far as we could, we then bisected what would normally represent the base of the bladder in the midline and conserved the vas on either side together with the structure in the floor of the urethra. We then carried the dissection down to the floor of the pelvis (Fig. 3), keeping behind the dense band of fibrous tissue which joined the rami, at the same time using great care not to enter the peritoneum. The peritoneum was easily pushed back and the rectum exposed. Two small incisions were made into the rectum, one on either side and about 1 centimeter from the mid-line (Fig. 4). The dissected ureter was then gently curved backward, and by means of a catgut suture inserted into the mucosa of the circular area, with a Kelly clamp in the rectum, the end was drawn through the opening into the rectum. By means of two catgut sutures placed on either side at the junction of the ureter and the rectum, the opening into the rectum was closed in such a way that the ureter was not constricted. Care was exercised to prevent the dissected ureter from being kinked or twisted at any point (Fig. 5).

Although both ureters were dissected out in a one-stage operation in our cases, there was no apparent disturbance in the kidney function. Hence we feel that, if the condition of the patient justifies it, the operation should be attended with less risk, and certainly it would appear that convalescence should be less complicated, when all of the urine is flowing into the rectum than when the operative field is constantly bathed with secretion from the

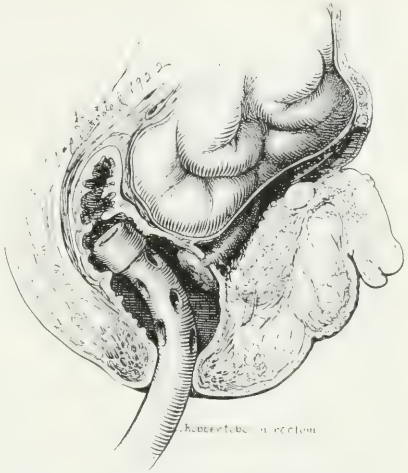


Fig. 7. Completion of the first stage in the operation. Rectal tube with fenestræ, in place.

undisturbed ureter. In our cases, the results have seemed to justify this conclusion. We did not feel, however, that it would be consistent with good surgical judgment to subject our patient to any further ordeal at that time. He had had enough for that day. This stage of the operation was therefore completed by closing the incision through the base of the bladder (Fig. 6).

Anticipating trouble as a result of leakage of urine around the ureter if the pressure in the rectum were allowed to rise sufficiently high, a rectal tube with fenestræ at various levels and with a cuff turned back at the end was inserted into the rectum, as soon as the patient was taken back to his room (Fig. 7). The secretion began to flow immediately

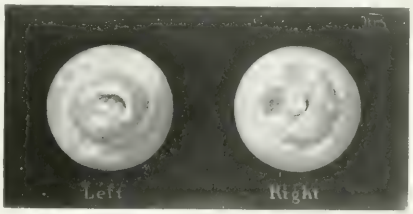


Fig. 8. Ureteral orifices as viewed through the proctoscope. Outer zone of smooth mucosa of the rectum, inner zone, elevated mucous membrane with a depressed ureteral opening in the center.

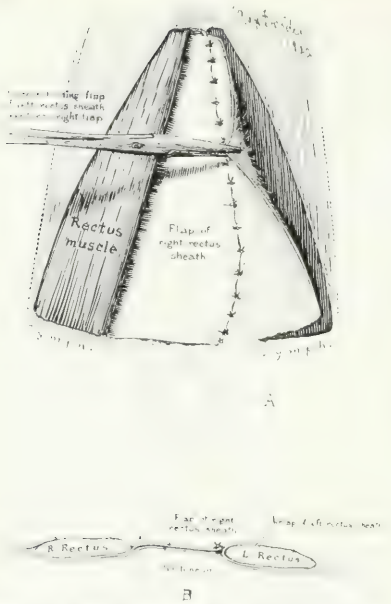


Fig. 10.—A, Skin and fascia dissected back on either side. Sheaths of recti split and overlapped in midline. *B*, Final step in plastic operation for cure of hernia, overlapping of the recti sheaths. Impossible to approximate the recti muscles. Pyriformes absent.

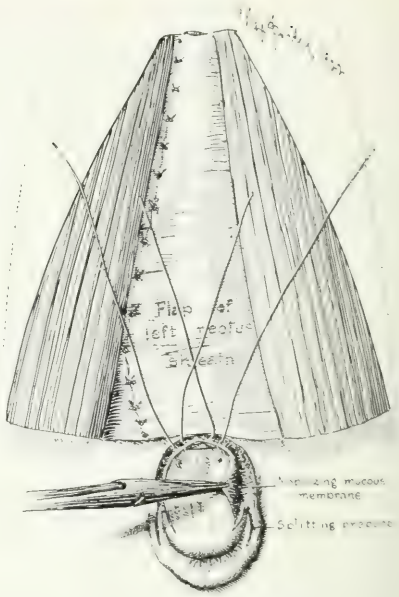


Fig. 11. Plastic operation on the penis for cure of epispadias. Mobilizing mucous membrane of urethra by incision along the mucocutaneous margin. Splitting of prepuce to complete the incomplete urethra.

and was collected in an appropriate receptacle. Although it was impossible to measure accurately the amount of urine, there was no appreciable embarrassment of the kidneys. Twenty-four hour specimens taken one week apart showed the following amounts of fluid recovered from the bowel:

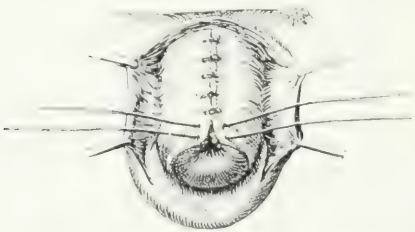


Fig. 12, *A*.

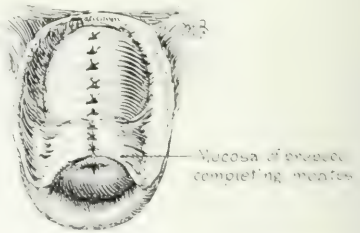


Fig. 12, *B*.

Fig. 12.—*A*, Union of the raw mucous membrane in midline to form inner lining of the roof of the urethra. Mucous membrane from either side [illegible] to the floor of the urethra and approximated with [illegible]. *B*, Completion of the incomplete roof of the urethra by means of flaps from the split prepuce on either side.

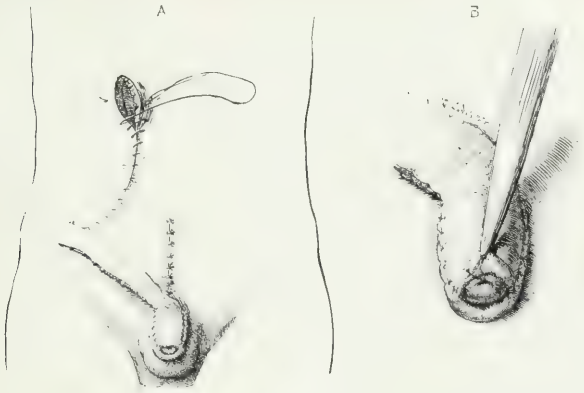


Fig. 13. *A*, Final step in plastic work on the penis. The outer skin forming the roof of the penis, consisting of a transplant taken from the right upper quadrant of the abdomen and sutured in place. *B*, The completed organ.

1800 cubic centimeters, 1607 cubic centimeters, 1900 cubic centimeters, 1350 cubic centimeters, 1580 cubic centimeters, 1350 cubic centimeters.

This, of course, contained bowel secretion but no gross fæcal matter.

On one occasion the rectal tube slipped out of its place, its absence remaining for a while undetected. During this time fluid was discovered escaping through the incision at the base of the bladder. This condition was corrected immediately by reinsertion of the tube. There was a resulting mild grade of infection in the incision, which responded readily to moist compresses.

The only disturbance observed as a result of the presence of urine in the rectum was a mild irritation for 3 or 4 days, the patient complaining of general abdominal pains, apparently due to increased peristalsis. There was no trouble from diarrhœa in either of our cases. Convalescence was uneventful.

During the next month, he was sent to the country under observation. As a rule he could retain his urine without discomfort for 5 hours, and on one occasion he went 7 hours without wetting himself. At times during the night, while he was asleep, a small amount of urine would escape. This, however, was the exception rather than the rule.

He grew rapidly, increased in weight, played with other children, and was a perfectly healthy looking boy. His teacher told us that he did very well in his work at school, and that she would not have known that he had ever been other than perfectly normal.

Figure 8 shows the result as observed through a proctoscope at the time of the second operation. There are two elevations irregular in outline with depressions in or near the center. Intermittent spurts of urine may be seen escaping from the depressions. The rectal mucosa is normal in appearance.

The second operation, October 26, 1917, was twofold in its object: (1) excision of the bladder; (2) cure of the hernia.

The bladder was completely excised down to the origin of the urethra (Fig. 9).

Radical cure of the hernia was effected by the following method (Fig. 10): After the bladder had been dissected out, a skin incision was made beginning at the apex of the defective area and extending down to a point in the midline where the bladder mucosa and skin had formerly met. The skin flaps, together with very thin layers of fibrous tissue, were dissected on either side to a line which extended from the apex of the triangle to points on the outer borders of the recti muscles, where they were attached to the pelvic rim. The sheaths of the recti were then incised, each incision beginning at the attachment to the pelvis at the outer border and extending upward and inward to a point where the two met, normally occupied by the umbilicus. The two sheaths were then dissected up, brought across the defective area by an overlapping method and sutured with interrupted chromic gut sutures (Fig. 10). The skin was closed with silkworm gut and silk. Healing by first intention followed.

The third operation was done in January, 1918.

The purpose of this operation was to correct by plastic means the defect in the urethra. A complete epispadias existed. The penis was shapeless, undeveloped, and poorly adapted to plastic efforts. Our purpose in completing the urethra was to attempt to establish the power of reproduction. To accomplish this an incision was made on either side

Fig. 14.—Result in a case of exstrophy of the bladder. Extensive scar formation at the site of the hernia operation. Penis viewed from the end, scrotum narrowed.

from the end of the organ, and extended to a point where the two incisions met just back of the beginning of the urethra (Fig. 11).

The tissues were then dissected on either side toward the midline leaving an area of the floor of the urethra untouched sufficient to insure a blood supply. The flaps were brought together in the midline, and sutured with very fine catgut sutures, care being exercised to avoid undue tension. There was no difficulty until the end of the organ was approached. At this point it was found that there was an insufficient amount of tissue available from the two sides to complete the roof of the urethra. This [illegible] by splitting the prepuce on either side and bringing it together in the midline, joining it to the margin of the uncompleted urethra [illegible] (Fig. 12). Although this does not make a smooth closure it acts very well.

The next step was to procure a transplant of skin appropriate for the occasion. For this purpose, it is important to secure a transplant of normal skin and subcutaneous tissues, free from stubborn hairs, possessed or capable of establishing a good blood supply, and adaptable to varying degrees of distensibility. On account of the poor circulation in the extensive scar formation and pubic hairs it was clearly evident that such a flap could not be obtained from the lower portion of the abdomen. It was, therefore, necessary to secure it in such a manner that the portion to be grafted on the penis should come from the upper abdomen with a pedicle in the lower abdomen so directed that when the transplant was placed it would not be twisted on its pedicle, but would undergo only a gentle reversal of its original position. To accomplish this, a graft broader than the area to be covered, to allow for contraction, was outlined, beginning about 5 centimeters internal to the anterior spine of the right ilium (Fig. 13), extending upward and inward, and then curving gradually upward and outward, of sufficient length to cover the desired area. In cutting the flap a moderately thick layer of fat and fascia was left with the skin in order to facilitate mobility and prevent disturbance in the reconstructed organ. The transplant was fastened in place by means of interrupted sutures, beginning at the distal end of the flap to be sutured to the margin of split prepuce used to reinforce or prolong the urethral roof. Although the fat and fascia of the transplant would in a measure permit comfortable distention of the organ, it was thought advisable to arrange the graft so that there would be relatively greater length of the transplant than of the original tissues of the penis. To accomplish this a sort of hump in the graft was allowed between each pair of interrupted stitches as they were inserted along the two sides of the penis. Naturally it occurred to us that it would be unwise to attempt to judge the proper length of the flap at the time of this operation. This and the fact that the blood supply deserved consideration convinced us that the final step should be deferred for several days, when we could determine just how much of the flap would be needed to complete the work comfortably.

The fourth operation, or final step in the third operation, was done about 10 days after the graft had been placed. Under local anæsthesia (0.5 per cent novocaine) the pedicle was divided and a liberal amount of the graft was sutured along the margin of skin at the beginning of the urethra. The stump of the pedicle was then shaped to fit the defect and sutured back in its original position. The remainder of the incision from which the graft had been removed was closed at the time the graft was cut. While the blood supply to the grafts, cut as ours were, is normally at right angles to the graft, and would appear to be deprived of blood, healing *per primam* took place in both cases.

Description of Case.—The penis is perfectly free and movable in all directions. The skin of the grafted

portion is white, retaining its original characteristics. Although there are undoubtedly free anastomoses between vessels of the graft and the penis, we do not believe the graft has assumed any function other than to act as a roof for the urethra, to complete the circumference of the organ, and to assist in maintaining the normal position. The transplant does not cause any sensation of increased tension.

So long as he commits no indiscretion of diet, the flow of urine in his rectum causes no untoward effect. If he abuses his stomach by indiscretion in eating, he is troubled with diarrhœa, which, however, clears up promptly under appropriate treatment.

The boy remained in splendid health until the influenza epidemic to which he succumbed on October 9, 1918, 17 months after the ureteral transplantation. Unfortunately, we did not get a postmortem examination.

Case 2. Male, age 20, referred by Drs. G. C. Blades and D. S. Fisher.

Physical examination shows a fairly well nourished and well developed adult. The deformity was similar in practically every way to that in our first case, except that this man had a double inguinal hernia, probably congenital. The left ureter was completely closed, no orifice could be found, no urine escaped during the examination or during the operation from this side. It was found with great difficulty by making a circular incision similar to that around the right orifice and dissecting down through the bladder until it was ultimately isolated. It was opened at the end and a catheter inserted.

The various stages of the operation were similar to those in Case 1. Case 2 was more easily handled on account of the larger size of the structures and better co-operation on the part of the patient in every way.

The results were equally gratifying. The patient can go 4 hours easily without voiding, although at times during deep sleep a small amount of fluid may escape.

Since the ureters were transplanted he is attending night school, has been on the stage as a dancer, has learned to swim, and enjoys other outdoor sports. He has secured and is filling with satisfaction a position with one of the big corporations of this city. If it be true that he contemplates matrimony in the not far distant future, a subsequent report may be of interest:

The following test was done during convalescence from a hernia operation, which was done under local anæsthesia:

Non-protein-nitrogen	63.0 mg. per 100 c.cm.
Urea-nitrogen	14.2 mg. per 100 c.cm.
Creatinine	1.7 mg. per 100 c.cm.

Although two cases are not sufficient to warrant definite conclusions, the almost perfect functional results which we have to report make us feel that exstrophy of the bladder with its accompanying epispadias is amenable to surgical treatment, and that these patients ought not to be allowed to go on in their wretched condition untreated. We have had no experience with exstrophy in females, but we see no formidable reason why they should not be equally benefited.

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KIELLAND OPERATION FOR PROLAPSUS UTERI

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IT is my purpose to describe a modification of an interposition operation which was devised by Dr. Chr. Kielland of Christiania, Norway, and which has for its purpose the placing of the uterus, in its entire length, on the anterior vaginal wall in a straight line, parallel to the vaginal axis (Fig. 11), and the narrowing of the vaginal caliber.

The vaginal portion of the cervix is pulled forward and upward so that the posterior surface of the prolapsus presents itself to the operator. Beginning at the cervical opening by excising a wedge of the posterior lip with a base scarcely 0.5 centimeter wide Fig. 1, *B*, (of course, the size depending upon the diameter of the portio) and continuing with downward incisions 6 to 8 centimeters in length, gradually diverging (Fig. 1, *A*). The flap between the incisions is separated from above downward, Fig. 1, *C*, but not cut off, and is placed beneath the retractor (Fig. 2, *A*).

It may happen, during the separation of the flap, that the peritoneum of the cul-de-sac of Douglas is opened. If so, then it must again be closed by suture. The vaginal mucosa, beginning at the edge of the incision on either side of the portio vaginalis and cervix, should be separated from the underlying structure, starting with a pair of blunt-pointed scissors, curved on the flat, and continuing with the finger to such an extent that the finger may surround it half way or even to a slightly farther extent (Fig. 2, *B*). The undermining must be done to within about 0.75 centimeter of the terminal of the portio vaginalis. At this part the scissors must be used, but one should be careful not to perforate the mucosa. The undermining and the wedge-shaped excision are necessary for the subsequent inversion of the portio and the cervix.

The posterior wound surface is now united for a length of from 6 to 8 centimeters, start-

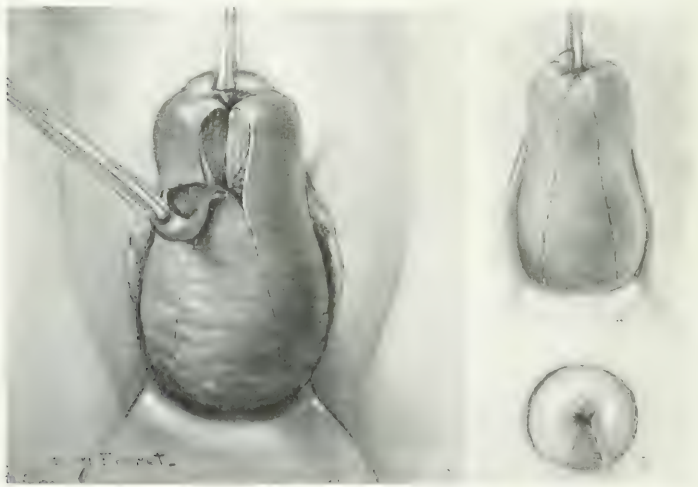

Fig. 1.—*A*, Incision on posterior surface. *B*, excision of cervical wedge. *C*, separation of the flap from above downward.

From the Surgical Service of the New York Post-Graduate Medical School and Hospital.

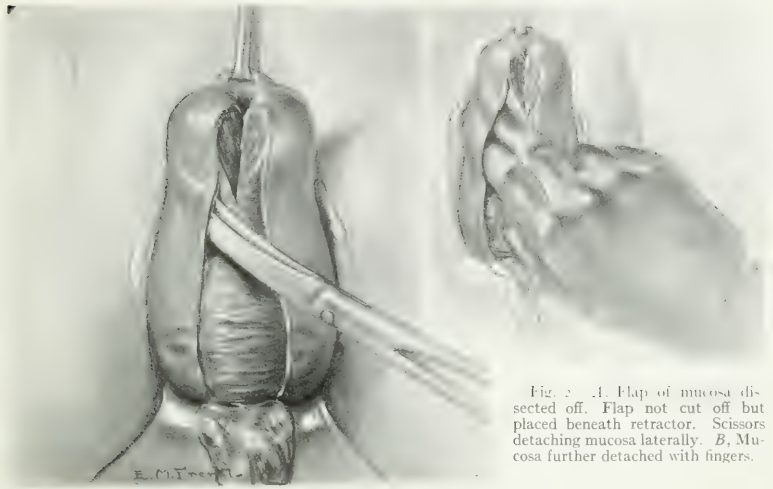

Fig. 2.—*A*, Flap of mucosa dissected off. Flap not cut off but placed beneath retractor. Scissors detaching mucosa laterally. *B*, Mucosa further detached with fingers.

ing at the posterior lip. This, however, applies to the mucosa only, for the underlying structures must not be included in the suture (Fig. 3). The suture is tied and left long, to be used for traction if desired, later, when inverting.

Now the vaginal portion of the cervix is drawn downward, and the anterior surface of the prolapse is operated upon. An oval flap is resected beginning about 0.5 centimeter beneath the urethral orifice and terminating at the cervical opening. This, then, excises the larger part of the urethral redundancy (Fig. 4).

A similar small wedge as was excised from the posterior lip is likewise excised from the anterior lip of the portio vaginalis; the size of this also depending upon the size of the portio vaginalis. In instances of broad, flat, mushroom-like vaginal portions, the excision must be larger; it must always be sufficient to make the portio somewhat conical for the purpose of inversion.

The width of the flap to be extirpated will depend upon the thickness of the tissue and the size of the existing cystocele. On either side of the prolapse there should remain about two fingers' width of the mucosa, if one wishes to retain a medium-sized vagina.

On the anterior surface the mucosa (after excision of the flap) should be separated about a finger's width (Fig. 5), and a little more toward the urethral terminus, because this part of the mucosa is destined to cover the anterior surface of the uterine body.

These edges are now grasped with two pairs of small mouse-toothed clamp forceps, about 0.6 centimeter, this side of the upper wound terminus, (Fig. 5), to enable one, more readily, to draw the mucosa in front of the uterine body when, later on, the wound is to be closed.

The bladder is now separated from the cervix, starting with the customary transverse incision, and pushed upward. The viscus should not be separated so far laterally as is usually done in the customary interposition operation, and the Luschka bladder pillars should not be injured.

When the vesico-uterine plica has been opened and the bladder catheterized for control, the body of the uterus is brought forward through the opening (Fig. 6.) The tubes are then ligated (I prefer to excise a part of each tube at the uterine cornu, H. J. B.) and the bladder peritoneum is attached to the posterior uterine surface at about the corpo-cervical junction.

Fig. 3. Posterior mucosa united. The finger is introduced only to show that the cervical musculature is not included in the suture.

Fig. 4. Mouse-toothed forceps grasping wound edge making it possible to draw the mucosa more readily in front of the uterine body when the wound is to be closed.

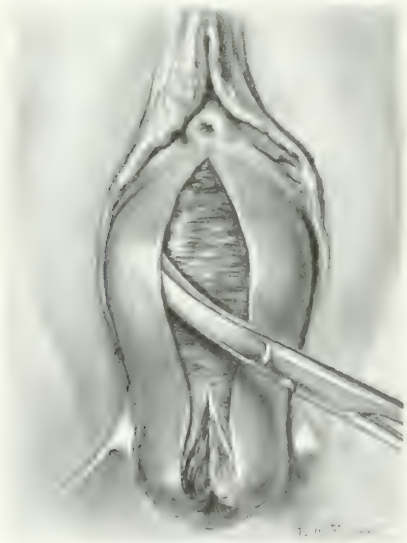

Fig. 5. Anterior flap turned out.

Kielland does not consider it essential to sew the peritoneum to the uterus, since this may cause a slipping back of the body into the peritoneal cavity, thus making somewhat tedious work, because of the necessity of bringing it forward again.

A gauze strip is placed down to the point of suture, between the bladder and the uterus, and brought out at the upper wound opening as a small cigarette drain.

The anterior vaginal wound may now be united by two methods:

1. A continuous suture of the vaginal wound, including the corpus uteri and the cervix in the suture, beginning at the wound's upper angle. The first suture, which includes the corpus, should be placed on the anterior surface of the fundus, not higher up than the origin of the round ligaments; *not at the sum-*

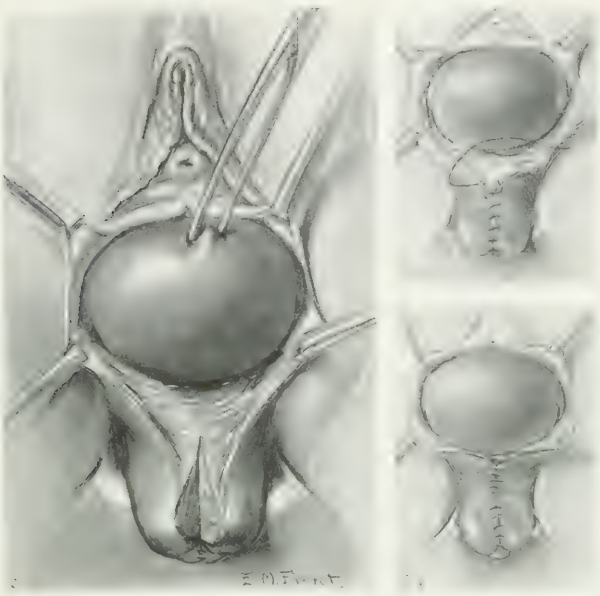

Fig. 6 (at left). The body of the uterus is brought forward through the opening.
Fig. 7. The cervix and the portio vaginalis are inverted into the vagina.

mti of the fundus nor on the posterior surface. This method, of using only a single line suture, is applicable only in instances of small prolapsus, or in the case of senile uteri.

2. As a rule, in the case of larger prolapsus, it is more convenient to make the suture in two stages. One begins at the lip of the cervix and sews upward to above the corpo-cervical junction. Here this suture is discontinued. The cervix is included in the suture. Now the cervix with the portio vaginalis may be inverted into the vagina (Fig. 7).

To accomplish this one finger presses upon the portio (Fig. 8), while simultaneously, the other hand pulls on the posterior vaginal flap, or on the knotted catgut suture left there when having worked on the posterior surface. When this has been done the distal half of the vagina has been formed. In the depth of this vagina one no longer feels a portio vaginalis; only the anterior lip and cervical opening are palpable. The posterior lip has been obliterated to touch.

Now the corpus uteri, if it is still protruding between the vaginal wound edges, is pushed back to its future position beneath the bladder. The vaginal wound edges, with the aid of the small-toothed forceps that have previously been placed upon them, are brought forward in front of the corpus. Should it be seen that there is too much vaginal mucosa for a moderately taut covering of the corpus, so much of the tissue as may be necessary should be excised.

The uniting of the edges should begin above, from the upper wound angle (where the gauze drain was placed, Fig. 9) and continued downward to the first suture. The stitches, beginning with the first, also take in the uterine musculature, at least every second stitch. A plastic operation upon the pelvic floor completes the operation. A Hegar flap is

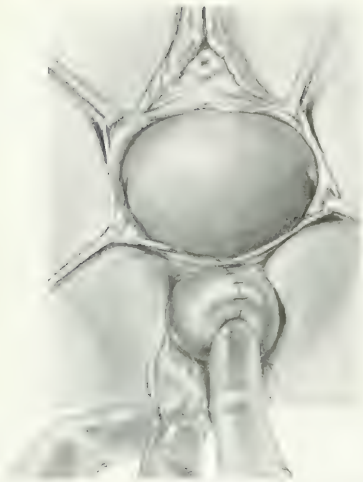

Fig. 8. Method of inverting cervix and portio vaginalis into vagina.

extirpated, by continuing the incision made for the posterior flap on the posterior vaginal wall (Fig. 1). The upper point of the triangular Hegar flap will lie at the catgut knot (Figs. 3 and 10). The external incision over the perineum *is not made transversely*, but bends into a point toward the anus (Fig. 10). The edges of the vaginal wound are united by a continuous catgut suture.

The underlying (venous) tissue is not taken in by the sutures in the Kielland operation. Only from about the carunculæ myrtiformis to the perineum the stitches penetrate more deeply on the lateral wall into the tissue. Interrupted sutures are used for the pelvic floor. The levators are not sutured, except in cases of rectocele. The perineum is united with somewhat deeply placed silkworm stitches or those of fine catgut.

Kielland also places a small glass tube, 3 to 4 centimeters in length, before placing the las stuture, and fastens it with the last stitch. This is removed on the evening of the operation day. (For this I have not found a neces-

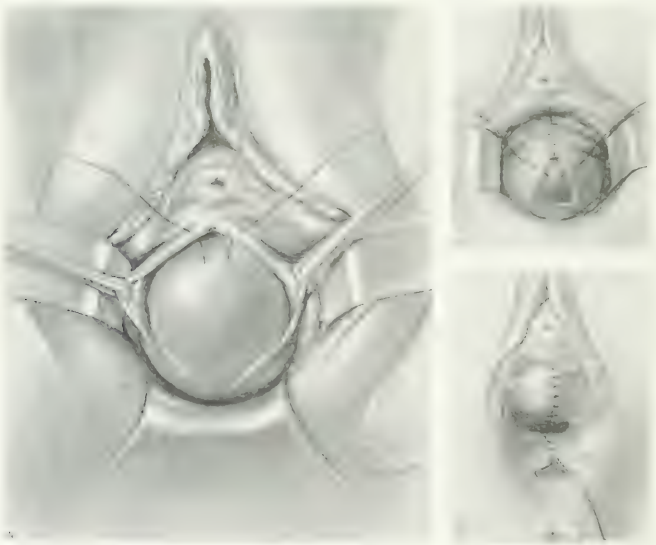

Fig. 9. A, Placing the last suture. B, continuing the suture.

sity, H.J.B.) The vagina is tamponed to the external orifice. A "T" binder is applied. The gauze strip or cigarette drain tampon is removed on the third or fourth day.

The operation, in a suitable instance, is not difficult from a technical point of view, since in cases of complete prolapsus the entire operation is done in front of the vulva. Only the suturing of the middle section of the anterior vaginal wall to the body of the uterus, and, possibly, the cervix and the upper part of the vaginoperineal plastic are done in the interior.

One of the most important factors in all interposition operations is the judgment as to how much of the anterior vaginal wall must be excised. If the uterine body has been placed too far forward with the fundus against the vagina, or if the vagina has been separated too far laterally, it is possible to have a cystocele-like protrusion immediately following the operation. If, on the other hand, the technique has been correct, one should see a plane surface, or still better, a slight retraction following the inward placement of the corpus uteri. When the cystocele-like bulging occurs it may be overcome by excising an oval-shaped flap from the vagina and a wedge-shaped excision from the uterine body; then closure of the wound.

Kielland asserts that in more than 150 such operations he has not seen one recurrence. The technique described has been used by him since 1911.

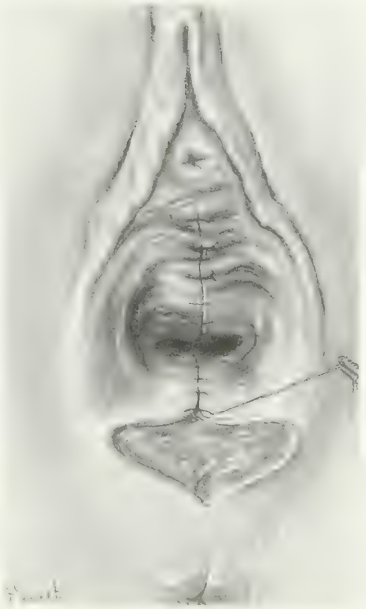

Fig. 10.

Fig. 11. Position of the uterus after completion of the operation.

Fig. 12. Position of uterus in original interposition operation, when vaginal part of cervix was not amputated.

The modification of Kielland refers principally to the treatment of the vaginal portion, which is not amputated but utilized as a prevention against a recurrence. The exclusion of a recurrence by this method of operating does not depend upon a lifting, suspension, or fixation of the vaginal portion, since this may be loosened by subsequent intra-abdominal pressure. The exclusion of recurrence depends upon static reasons: The position of the uterus is straight and in parallel position with the axis of the vagina (Fig. 11). Intra-abdominal pressure acts on the posterior surface of the uterus and transversely to its long axis, and, therefore, presses the uterus against the posterior vaginal wall—and not out of the vaginal outlet (Fig. 11).

Because of the retention of the entire uterus, the anterior vaginal wall has become more rigid, so that with the change of the vagina the organ cannot be pressed out.

Kielland claims that, inasmuch as no levator suture is used, except in instances in which rectocele is present, it is proved that levator suturing is not required in cases of prolapsus uteri.

FRACTURES IN TRANSPLANTED BONE

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THE success of an entire graft of any tissue is dependent upon the ability of the cellular elements of that particular tissue, to remain viable after the complete severance of its vascular supply and thereby retain its life properties until such a time as its vascular supply is re-established. This temporary destruction of its blood supply with the loss of the essential nutrient elements, necessarily inflicts a considerable injury to the cellular components of the graft, which in part undergo more or less degenerative changes, and some of the cells may even die. In the case of the bone graft it is believed by the majority of investigators that many of the osteoblastic cells of the transplant survive and at least share in the regenerative processes. Their deductions are based on the results of careful microscopical study of transplanted bone, especially of bone buried in muscle. On the other hand, some investigators still maintain that there is practically a complete degeneration of the cells of the transplant and that all active regenerative changes are dependent upon a secondary ingrowth of osteoblastic tissue from outside of the graft.

It is of prime importance in considering the healing of fractures in transplanted bone to know definitely if the cells of the transplant possess an independent, inherent power of proliferation and repair. If the osteoblastic tissue of the graft is inactive then the healing and callus-forming cells are dependent upon an invasion from the exterior into the transplant. Therefore, if a fracture occurs in a transplanted piece of bone before such an invasion takes place, its healing will have to wait until such a time as the new osseous elements will have reached the site of the break. On the other hand, if the graft possesses independent powers of proliferation, then the reparative activities will proceed at once and may be completed before the penetration of new bone from the host. Thus, it is seen, that it is of considerable importance, both from the scientific as well as from the clinical aspect to determine if the cells of the transplant are endowed with this power of proliferation and repair.

Almost every surgeon who has utilized the free bone transplant has experienced the occurrence of a fracture of a graft. In a recent article, S. Alwyn Smith (1) gives some interesting data and views on fractures taking place in grafts of bone. He is of the opinion that the greater part of the graft dies and is absorbed and replaced by osteoblasts derived to a certain extent from the surface, but principally from the endosteum of the host bone at either end. He believes that the graft acts as a scaffold for the ingrowing bone from the host. Smith divides the fractures occurring in transplants, into two types: One, the disintegration fracture occurring about the sixth to the eighth week at a time when absorption outstrips restitution, and due to stress or strain associated with the lack of rigid immobilization. The other type, he designates as the clay pipe stem fracture, which occurs about the third or fourth month after operation and at such a time when the graft depends entirely on its mineral constituents for its strength. Unfortunately, this subject can not be dismissed with this simple classification and explanation of the causative factors. Other elements must be considered as playing a rôle, such as infection, variable tissue reactions, failure of certain necessary chemical elements, and disturbances in various glandular or other physical properties of the individual.

Little direct experimental work has been done upon this important subject. Phemister (2) in his admirable article on the study of the fate of transplanted bone gives a few observations on fractures taking place in some of the grafts. He found that union took place in the fractures of the reimplanted bones and concluded that the reparative processes were

due to the independent active power of proliferation, residing in the transplant itself. His experimental proof is open to criticism because the transplants were in contact at one or both ends with the normal bone of the host, thereby offering the possibility of an ingrowth or migration of osteoblastic cells from this normal bone.

The author (3) in a recent article has presented some evidence of the inherent power of regeneration in a transplanted piece of bone and in the present article will endeavor to give additional proof of this principle, as well as consider the healing of fractures in such bone.

In studying the healing of fractures in transplanted bone one must take into consideration two processes: namely, the healing of a fracture and the fate of bone after transplantation. In order to obtain a better conception of this problem it is advisable to review briefly the method of repair that takes place in each instance.

Let us first take up the pathological changes that occur after the fracture of a bone. We have become so familiar with the normal healing of a fracture that we merely think of it as a simple process of formation of callus which unites the two ends of the fragments and its subsequent ossification, and we seldom stop to consider the intricate system of regenerative changes which are necessary before the final restitution and repair of the injury is completed. However, I believe, it will be accepted, that with the possible exception of the changes that take place in a bone after transplantation, the healing of a fracture makes more demands upon the natural reparative powers of the body than the repair of any other tissue of the organism. We see immediately after the injury, following the rupture of the vessels, an outpouring of blood and lymph. In response to this stimulation there takes place an inflammatory reaction, most often aseptic, in the surrounding area which is followed by the formation of granulation tissue and organization of the blood clot. Simultaneously one sees evidences of activity in the osteogenic cells about the end of the bone fragments. This is manifested by an increase in number and size of the osteoblastic cells in the region of the periosteum, the endosteum, and about the haversian canals. With the proliferation of these cells there is formed the cartilaginous callus which invades the already formed suitable pabulum of organized blood. The whole process of bridging the gap between the two bone fragments proceeds in a purposeful manner. The temporary cartilaginous callus is transformed into osteoid tissue, which, in turn, becomes calcified to form bone. After the resumption of use of the part, there is an absorption of unnecessary tissue and new bone is layed down where it is required, so that in time there is practically a re-establishment of the normal form of the bone.

If we now direct our attention to the study of a piece of bone after transplantation, it will be found that at first because of the sudden complete destruction of its blood supply and other sources of nourishment, there takes place shortly after removal almost a complete degeneration of its cellular elements, as is evidenced by the changes in the nuclear staining. After this initial stage of degeneration, there is a proliferation of the more resistant osteogenetic cells that have survived, and one finds a proliferation of new bone about the region of the periosteum, the endosteum, the lining of the haversian canals, and on the surface of the trabeculæ. From these various foci of activity, the bone is restored to almost a normal condition. The processes just enumerated take place in transplanted bone, whether it be in contact with live bone or whether it be placed in a muscle and separated and prevented from any possibility of contact with other osseous tissue.

Now having in mind these two systems of repair and regeneration occurring on the one hand in a fractured bone and on the other hand in transplanted bone, under independent conditions and separate environments, let us try to picture what would occur if there should be a demand for both processes to take place at the same time. In considering such phenomena, the question naturally arises as to whether there would be sufficient energy for the repair of a fracture in a transplanted bone, in addition to that required for

the regeneration of the transplant itself? If not, would there be some attempt at repair and in just what manner would this be manifested? Furthermore, would there be a difference both quantitatively and qualitatively in the reaction under functional stimulation or when such stimulation was lacking? In order to obtain some information on the above problems the following series of experiments were performed upon dogs. The operations were done under general ether anæsthesia and with the usual aseptic technique.

In the first group of experiments, an entire metacarpal or metatarsal bone with both its articular cartilages intact, was removed from the animal's foot. The bone was then fractured about the center and the two fragments after being placed in apposition, were reimplanted in the normal position in the foot. The bone thus treated necessarily had its entire blood supply destroyed. In these experiments in which the bones are replaced in the foot, there is the possibility of osseous union with the neighboring bones. In such a case the findings would be open to the criticism that the ingrowing bone exerted an influence on the formation of the callus and that it was not an independent activity of the cells of the transplant.

In the second group of experiments an entire bone was removed from the foot and after being fractured was transplanted to the muscles of the back. The two fragments so buried in the muscles are removed from any possible osseous contact and any proliferative changes taking place must be due to the energy residing in the cells of the transplant. Because of the fact that the bone in the muscle is in an abnormal position and not subjected to the influence of normal functional stimulation, added emphasis must be given to any constructive changes that may arise therein.

In the third group of experiments a similar procedure of reimplantation and transplantation was carried out, with the exception that the fragments were placed in boiling water for about 10 minutes. This was done to determine if the surrounding tissues exerted any influence or formed any active osteogenetic tissue.

Fig. 1. Fig. 2. Fig. 3.

Fig. 1. Experiment 3. Duration 71 days. The bone, *A*, *B*, was removed from the foot and after being fractured was replaced in its normal position. Notice the large amount of callus at site of fracture. The callus is not completely ossified but gross examination showed firm union.

Fig. 2. Experiment 4. Duration 71 days. The bone *A*, *B*, was removed from the foot, fractured in the middle, and reimplanted in the normal position. Notice the large callus at the site of the fracture. Although this callus was not completely ossified, there were definite signs of firm union on gross examination.

Fig. 3. Experiment 6. Duration 116 days. The bone *A*, *B*, was removed from the foot, fractured in the center, and reimplanted in its normal position. The line of fracture is completely ossified. There is a slight bulging of the shaft at the site of union. The bone is of normal density but is thickened throughout its entire length.

In the fourth group of experiments, one fragment of bone was boiled and the other was not injured. After being placed in apposition they were either reimplanted or transplanted to the muscles of the back. This was done to determine if the normal bone under such adverse conditions would exert any influence over the boiled dead half.

EXPERIMENTS

Group I.—Fractures in Reimplanted Normal Bone

Experiment 1. Duration 14 days. Dog 6

Operation. The fourth metatarsal bone was removed from the foot. It was then fractured in the center in a jagged line, and the two fragments were replaced in their normal position.

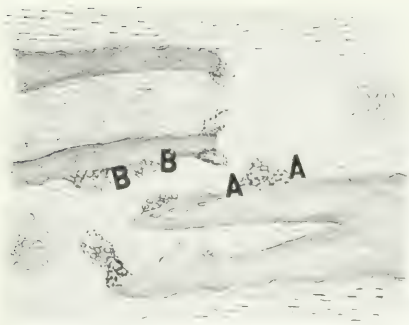

Fig. 4. Experiment 7. Duration 33 days. Diagramatic drawing of two fragments of a fractured bone that was buried in muscle and removed after 33 days. At the ends of the fractured bones, which were overlapping, there were definite outgrowths of bone and cartilage. It is to be noted that these outgrowths are found only within the neighborhood of the planes passing through the ends of the fragments of bone. In other words, it is a purposeful attempt to unite the two fragments by callus formed from the osteoblastic tissue of the transplanted bone. Photomicrographs of the outgrowths indicated by *A*, *A* and *B*, *B* are shown in Figures 5 and 6.

Gross examination. 14 days. The bones were found in good position. They had adhered to the surrounding tissues and showed no abnormal reactions. At this early period, there was no gross evidence of union. The specimen was preserved intact.

Experiment 2. Duration 33 Days. Dog 2. Full Grown

Operation. Removed the fourth metacarpal bone of the left fore foot, fractured in the center, and reimplanted in its normal position.

Gross examination. 33 days. Dog 2. The fractured ends were found in poor alignment. There is no evidence of callus, and the ends of the bone appear smooth.

Microscopical examination. The two fragments, which are not in apposition, make an angular deformity. In this angle there is a considerable amount of cartilaginous callus. The cortical bone contains both stainable and non-stainable nuclei. There is some new periosteal new bone, but no evidence of activity about the endosteum.

Experiment 3. Duration 71 Days. Dog 3. Full Grown

Operation. Removed the third metacarpal bone of the left fore foot, fractured it completely across the shaft except for a small strip of periosteum along one side, and then reimplanted in the normal position.

Gross examination. 71 days. There was a fairly large callus at the site of the fracture and one got the impression of firm union. The roentgenogram (Fig. 1) shows the large amount of callus at the fracture, which with the exception of the central part has ossified. The specimen was saved intact.

Experiment 4. Duration 71 Days. Dog 3. Full Grown

Operation. Removed the third metatarsal bone completely from its bed and after fracturing completely through the center, leaving a strip of periosteum along one side, the two fragments were placed in their normal position.

Gross examination. 71 days. The bones were found well healed in the position in which they were placed. There was firm union at the site of the fracture. The roentgenogram (Fig. 2) showed considerable callus which was not completely ossified. The bones showed only slight evidence of absorption and were of fairly normal density.

Microscopical examination. There is a complete connecting callus between the two fragments. The portion adjoining the bone ends is osseous while that near the center of the gap is cartilaginous. The method of the laying down of the callus is not unlike that which takes place through the healing of any fracture. There is a marked osseous proliferation along the outer side of the cortex beneath the periosteum.

Experiment 5. Duration 73 Days. Dog 1, Full Grown

Operation. In this experiment the first phalanx of the third toe of the right foot was removed and fractured in the center. If was then reimplanted in its normal position.

Gross examination. 73 days. Dog 1, full grown. Subsequent to the operation the fragments became displaced. There was no evidence of union. The specimen was not studied microscopically.

Experiment 6. Duration 116 Days. Dog 4. Young

Operation. Removed the third metacarpal bone from right fore foot and after fracturing in the center, it was reimplanted in its normal position.

Macroscopical examination. 116 days. The fragments have united firmly, and it is almost impossible to make out the old fracture line. On longitudinal section one sees an irregular contour to the shaft. The roentgenogram (Fig. 3) shows complete osseous union at the site of fracture. The bone is thicker than the normal neighboring bones and is just as dense. There is a union of base with the adjoining bones.

Microscopical examination. There is an irregular structure of the cortical bone. In places the nuclei have a fairly normal structure and take the usual stain, while in other parts of the bone they take a poor stain and have a degenerated appearance.

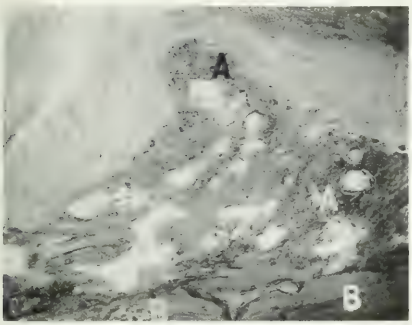

Fig. 5. Experiment 7. Duration 33 days. Photomicrograph of the area designated by *A*, *A* in Figure 4. *A*, New osteoid tissue growing out from the original cortex. Notice the group of cartilage cells at the tip of this mass. *B*, the original cortex. This callus is similar to the callus that forms at the site of a fracture under normal conditions. It is projecting toward the cortex of the other fragment in an endeavor to form a union between the two. The original cortical bone contains faintly staining nuclei and is undergoing a more rapid degeneration than this new tissue arising from its outer surface.

Fig. 6. Experiment 7. Duration 33 days. Photomicrograph of the area marked *B*, *B* in Figure 4. *A*, *A*, Mass of cartilage in the osteoid callus projecting from the cortex of a transplanted piece of bone which was buried in muscle. *B*, *B*, Original cortex of the transplanted bone. Because of the fact that this bone was buried in muscle and therefore removed from the possibility of contact with other osseous tissue, it is held that the callus arose from the persistent osteogenetic cells of the transplanted bone.

SUMMARY ON REIMPLANTED FRACTURES

In three of the six experiments in this group there was definite union of the fractures in the reimplanted bones. In a fourth there was callus about the ends of the fragments, which had separated and made an angular deformity. In the remaining two, the period of observation was too short in one, while in the other the fragments became widely separated following the operation.

The method of union was similar to that which takes place in fractures of undisturbed bones.

Group II. Fractures in Transplanted Normal Bones

Experiment 7. Duration 33 Days. Dog 2, Full Grown

Operation. Removed the third metacarpal bone of the left forefoot and fractured it completely through the cortex, leaving a strip of periosteum along one border. The two fragments were then transplanted to the muscles along the left side of the spine.

Gross examination. 33 days. The bones were found embedded in the muscles of the back. The two fracture ends overlap each other. There appears to be a partial union.

Microscopical examination. The two bone ends, which are not in osseous contact overlap each other, and show some very interesting and instructive cellular changes. It is noticed that in the plane where the bone end of one fragment projects on the shaft of the other fragment, there is an outgrowth of bone attempting to bridge the gap. These outgrowths consist of both osteoid and cartilaginous tissue and are of the same nature as the callus that bridges the gap between any two fragments of fractured bone. This is well shown in the diagram (Fig. 4) and the photomicrographs (Figs. 5 and 6). It is further noticed that at no other place on the cortex is there any evidence of bone proliferation. In other words this is a purposeful attempt to bridge the bone gap and definitely due to the inherent active osteogenetic power of the cells of the transplant. If the tissues external to the bone were responsible then one would expect a uniform change of all the intervening tissue as well as changes at other places along the surface. The original bone of the cortex contains granular nuclei which are larger than normal and appear to be in a stage of degeneration. Some parts of the bone contain normal nuclei, especially about the periphery and along the haversian canals. Except for the periosteal and endosteal borders, it is noticed that the ends of the fragments show an entire lack of activity.

Experiment 8. Duration 33 Days. Dog 2, Full Grown

Operation. Removed the third metatarsal bone from the right hind foot and after fracturing com-

pletely through the center, the two fragments were placed in apposition and buried in the muscles along the right side of the spine.

Gross examination. 33 days. The two fragments became separated so that a non-union took place. One of the fragments was removed, at that time and the other 10 days later.

Microscopical examination. 33 days. There is some new bone proliferation at the ends of the fragments which arises from the haversian canals or from the periosteum. There is evidence of new bone about the periosteum, endosteum, haversian canals, and about the trabeculæ.

Microscopical examination. 43 days. The remaining piece of bone which was removed 10 days later showed no signs of activity. This difference might be due to the injury and disturbance produced by the second operation.

Experiment 9. Duration 71 Days. Dog 3. Full Grown

Operation. Removed the fourth metacarpal bone from the left fore foot. The bone was fractured in the center, the two fragments placed together, and then transplanted to the muscles on the left side of the spine.

Gross examination. 71 days. The two fragments were found in alignment. On manipulation one can detect some mobility at the site of fracture. The roentgenogram showed very little callus at the site of union. At one place there appears to be a connecting osseous bridge (Fig. 7).

Microscopical examination. On one border there is a mass of cartilage between the two ends, which in a series of sections seems to connect the two fragments. The bone ends appear blunt and show no signs of activity. The cortex for the greater part contains stainless nuclei.

Experiment 10. Duration 71 Days. Dog 3. Full Grown

Operation. Removed the fourth metatarsal bone from the right hind foot. The bone was broken in the center leaving a strip of periosteum along one side, and then transplanted to the muscles of the left side of the spine.

Gross examination. 71 days. The bones were found embedded in the tissues of the back, in good position and with firm union. The bones are thinner than normal and have undergone considerable absorption. The roentgenogram (Fig. 8) shows that there is no excessive callus and that which has formed is not completely ossified, as the line of separation is still visible.

Microscopical examination. There is a definite osseous bridge connecting the two fragments. The nuclei of this connecting bone are not exactly normal and might be undergoing degeneration. The nuclei of the original cortex show a much more advanced degeneration, in fact are almost stainless. This would seem to indicate that, after the initial proliferation and repair of the fracture, both the original bone and the new-formed callus undergo degeneration, but the degeneration takes place slower in the latter.

Experiment 11. Duration 77 Days. Dog 1, Full Grown

Operation. In this experiment the first phalanx of the fourth toe of the right foot was removed and fractured in the center. It was then transplanted to the muscles on the right side of the spine.

Gross examination. 73 days. There appears to be definite union of the fragments with slight angular deformity. The roentgenogram showed complete osseous union (Fig. 9).

Microscopical examination. There is definite osseous union at the site of fracture. The bone for the greater part contains stainable nuclei. There has been considerable absorption of the cortical bone.

Experiment 12. Duration 78 Days. Dog 1. Full Grown

Operation. Removed the first phalanx of the fourth toe of the left hind foot, and after fracturing in the middle, transplanted it to the muscles of the left side of the spine.

Gross examination. 73 days. The bone was found in the muscle and union appeared to be quite firm, in spite of the fact that there was considerable absorption. The roentgenogram showed union.

Microscopical examination. There is definite new osseous tissue connecting the two fragments. The nuclei of this tissue stain better than the original cortex. The new bone arises chiefly from the periosteum and endosteum and resists absorption better than the remainder of the cortical bone.

Experiment 14. Duration 116 Days. Dog 4. Growing

Operation. Removed the fourth metacarpal bone from the right fore foot and after fracturing in the middle, transplanted the two apposed fragments to the muscles along the right side of the spine. A strip of periosteum was left intact along one border.

Gross examination. 161 days. The bone has undergone considerable absorption and is quite pliable. The roentgenogram showed complete osseous continuity between the two fragments. The bones have undergone considerable absorption throughout their entire extent (Fig. 10).

Microscopical examination. The microscopical study shows that there is continuous osseous tissue between the two fragments. The new bone stains better than the original cortex and is more resistant to absorption than the remainder of the bone from which it arises.

SUMMARY ON FRACTURES IN TRANSPLANTED BONES

In five of the seven experiments in which fractures were produced in bones that were buried in muscles, there was definite evidence of union of the fractures. The healing varied from the cartilage to the osseous stage, and proceeded in a similar manner to the healing of a fracture in a normal bone.

Because of the fact that a bone buried in muscle is removed from any possibility of osseous ingrowth from other bones, it appears that one is justified in concluding that the callus arises from the osteogenetic cells of the bone of the transplant.

It is an interesting fact that this new bone seems to be more resistant than the original bone of the transplant. However, both the new and old bone undergo a progressive absorption, because of the fact that they are removed from the possibility of normal functional stimulation.

COMPARISON OF THE REIMPLANTED AND TRANSPLANTED BONES

There is a greater amount of callus formed in the reimplanted bone than in the transplanted bone. This is possibly due to the fact that the reimplanted bones are almost immediately subjected to functional stimulation and, therefore, there is a greater amount of motion and a need for an early means of strength, which is most rapidly supplied by an abundant cartilaginous callus.

There is less evidence of absorption in the reimplanted than in the transplanted bones.

There is the obvious possibility of a greater number of failures of union in the reimplanted bones because of the movements of the limb, with resulting displacement of the fragments.

BOILED BONE

Certain investigators, notably Petrow and Baschkirzew (3) have claimed that the new osseous tissue forming in a transplanted piece of bone, arose from an ingrowth of young connective tissue, which by a process of metaplasia was changed to osteoblasts and formed the new bone. Likewise, it might be maintained that the new osseous tissue and callus that united the fractures in the transplanted bone, arose from the surrounding tissue and was not formed from the osteogenetic cells of the transplant itself. In order to determine if there is a possibility of such a metaplasia, it was decided to utilize dead osseous tissue instead of live bone. If the bone could be formed from this surrounding connective tissue, it would be expected that it would have the same possibility of changing in the dead as in the live bone. To investigate the behavior of dead bone the following experiments were performed upon dogs.

Fig. 7. Fig. 8.

Fig. 7. Experiment 9. Duration 71 days. Roentgenogram of a fractured bone buried in muscle for 71 days. There is very little evidence of callus. The gross examination of the specimen showed partial union. Microscopically a considerable mass of cartilage connects two fragments.

Fig. 8. Experiment 10. Duration 71 days. Roentgenograms of a fracture in a transplanted bone removed from the muscles of the back at the end of 71 days. Notice that there is no excessive callus like that found in the reimplanted bones. Grossly there was firm union, verified as being due to osseous callus by microscopical examination

GROUP III. FRACTURES IN REIMPLANTED BOILED BONES

Experiment 15. Duration 8 Days. Dog 8, Growing

Operation. Removed the third metacarpal bone from the left fore foot and fractured in the center. The bones were boiled for 15 minutes and then reimplanted in their normal position.

Gross examination. There was no attempt at healing. Infection.

Microscopical examination. There are no signs of proliferation. The nuclei stain poorly and are quite irregular.

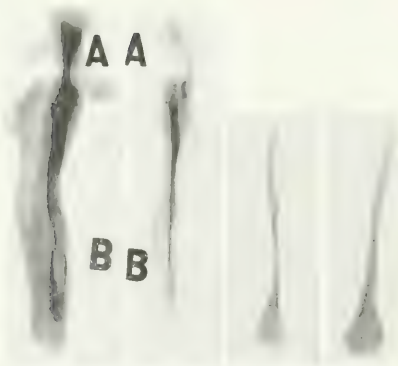

Fig. 9. Fig. 10

Fig. 9. Experiment 11. Duration 73 days. Roentgenogram of a fractured phalanx removed from the muscles of the back at the end of 73 days. Two views in planes at right angles. *A, A*, Phalanx. Notice that union is completely osseous, also that there is a considerable absorption of bone. *B, B*, Metacarpal. Not for consideration in this paper.

Fig. 10. Experiment 14. Duration 116 days. Roentgenogram of a healed fracture in a transplanted bone removed from the muscles of the back at the end of 116 days. Two views at right angles. There is complete osseous union. Atrophy of entire metacarpal bone shows that after initial reparative process a secondary degeneration with absorption takes place because of lack of functional stimulation.

Experiment 16. Duration 14 Days. Dog 6. Growing

Operation. Removed the third metacarpal bone from the left fore foot, fractured it in the center and after boiling, reimplanted the two fragments in normal position.

Gross examination. The bones were found to be slightly displaced but showed no signs of proliferation. They were very loosely attached to the surrounding tissues.

Experiment 17. Duration 93 Days. Dog 8. Full Grown

Operation. Removed the third metacarpal bone from the left fore foot. The bone was fractured in the middle, boiled for 5 minutes, and then reimplanted in its normal position.

Gross examination. The bones were found in the position in which they were placed but loosely agglutinated to the surrounding tissues. The bones have the white color of dead bone. The roentgenogram shows considerable erosion of the distal fragment, although the density is about the same as the [illegible]

Microscopical examination. There is absolutely no sign of callus or any signs of proliferation about the bone ends or in the surrounding tissue. The picture is one of absorption. The nuclei of the cortex are stainless and granular, except for a few in the region of the articular cartilage. These take a heavy stain and appear more nearly normal, which might be due to the fact that they were well fixed by the heat and more resistant to absorption.

Experiment 18. Duration 93 Days. Dog 8, Full Grown

Operation. Removed the third metatarsal bone of the right hind foot and fractured it in the center. The bones were then boiled for 5 minutes and reimplanted in their normal position.

Gross examination. The wound became infected. The bone that remained showed considerable evidence of absorption.

Experiment 19. Duration 113 Days. Dog 9. Growing

Operation. Removed the third metatarsal bone of the left hind foot and after fracturing in the center, the fragments were boiled for about 4 minutes. The two segments were then placed in apposition and reimplanted in their normal position.

Gross examination. At first inspection it was thought that the two fragments had united. Further examination showed that this apparent stability at the site of union was due to the ingrowth of bone from the adjoining normal bone. The roentgenogram shows this union of the transplanted boiled bone with the adjoining normal bone, as well as the absorption of the bone (Fig. 12). There has been a malalignment of the two fragments.

Summary on Fractures in Reimplanted Boiled Bones

In none of the experiments with boiled bones were there any signs of proliferation or new formation of bone.

There was no evidence of changes in the surrounding connective tissue or of the connective tissue that penetrated the boiled bone.

The boiled bone acted as a foreign substance and showed evidence of degeneration.

With boiled bone there appeared to be a greater tendency toward infection and more likelihood of a separation of the fragments. This separation might be due to the lack of the early welding callus.

Group IV. Fractures in Boiled Bone Transplanted in Muscle

Experiment 20. Duration 8 Days. Dog 7. Young

Operation. Removed the fourth metacarpal bone from the right fore foot, fractured in the center.

Fig. 11. Fig. 12 Fig 15.

Fig. 11. Experiment 17. Duration 93 days. Roentgenogram of a fractured boiled bone that was reimplanted in its normal position. *A*, *B*, The two boiled segments of bone. The two fragments, which are in mal-alignment show absolutely no signs of union or proliferation about the ends. This is in marked contradistinction to the proliferation and union of reimplanted live bones that were fractured. In the gross specimen the bones appeared dead with no signs of new bone. Microscopical examination showed entire absence of proliferation about ends.

Fig. 12. Experiment 19. Duration 113 days. Roentgenogram of a fracture in a boiled bone reimplanted in its normal position. In this case there was considerable stability at the site of union. The picture shows that this was due to a union of the distal fragment with the adjoining normal metatarsal bone, as well as the proximal fragment at its base, and along the shaft. This exemplifies the point that reimplantation experiments are open to criticism because of the possible invasion of live osteoblastic elements from the adjoining bones.

Fig. 15. Experiment 28. Duration 113 days. Roentgenogram of a reimplanted bone of which the distal half was alive and the proximal half boiled before being placed in its normal position. *A*, Distal live half that was merely removed and then reimplanted. *B*, Proximal boiled half. There is a large amount of callus at the site of junction of the two segments. This callus originates from the normal live half and invades the dead part. Line of union is evident because ossification is not complete. Gross examination showed firm union. Microscopical study revealed a complete callus, partially osseous, partially cartilaginous.

boiled for 10 minutes, and then transplanted the two apposed fragments to the muscles of the back.

Gross examination. There was an infection of the wound. The bones were found loose in the muscles with very little change in the structure.

Experiment 21. Duration 8 Days. Dog 7, Young

Operation. Removed the third metatarsal bone from the left hind foot, fractured in center, boiled for 15 minutes, and transplanted to the muscle of the left side of the spine.

Gross examination. The bones were found loose in the muscles of the back. There was infection of the surrounding tissues.

Fig. 13 Fig. 16. Fig. 17.

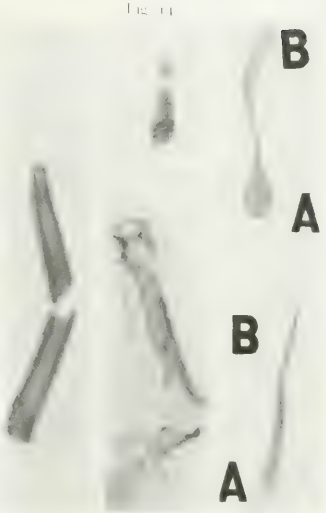

Fig. 13. Experiment 24. Duration 93 days. This is a roentgenogram of a fracture of a boiled bone, which was buried in the muscles of the back and removed after the elapse of 93 days. There is an entire absence of callus or attempt at proliferation. There is no evidence of a metaplasia of the surrounding connective tissue to form callus between the two fragments.

Fig. 14. Experiment 26. Duration 113 days. Roentgenogram of a fractured boiled bone that was buried in the muscles of the back and removed after 113 days. Proximal fragment has been almost entirely absorbed. There is no evidence of union. Microscopical examination revealed no evidence of callus or proliferation about fracture line

Fig. 16. Experiment 33. Duration 95 days. Roentgenogram of a fractured bone of which one-half was boiled before transplantation to the muscles of the back, where it was placed in apposition with the other normal segment. *A*, Live segment. *B*, Boiled segment. There is no evidence of union. The boiled half has undergone very extensive absorption. The live half shows less evidence of absorption. There is a slight amount of proliferation about the end of the live half, which is verified by the microscopic study.

Fig. 17. Experiment 34. Duration 113 days. Roentgenogram of a fractured bone buried in the muscles of the back. One segment was boiled before transplantation while the other was placed in its normal live condition. *A*, Boiled segment. *B*, Live segment. There is complete osseous union between the boiled and the live bone. Note the marked absorption, especially of the boiled segment. Roentgenograms taken in planes at right angles.

Microscopical examination. The nuclei of the bone stain, but are larger than normal and have a degenerated appearance.

Experiment 22. Duration 14 Days. Dog 6, Growing

Operation. Removed the fourth metacarpal bone of the left fore foot and, after fracturing in the middle, the fragments were boiled and placed in the muscles on the left side of the spine.

Gross examination. The bones were found in the muscles to which they were but slightly adherent. There were no signs of union.

Microscopical examination. The nuclei stain fairly well. Their form is more irregular than normal, more granular in structure, and larger in size. There are no signs of proliferation at any place.

Experiment 23. Duration 15 Days. Dog 14, Full Grown

Operation. Removed the fourth metatarsal bone of the right hind foot. Fractured the bone in the center, boiled for about 5 minutes, and transplanted the two apposed segments to the muscles on the right side of the spine.

Gross examination. The bones are found in the muscle with no signs of union and very slight agglutination with the surrounding tissues. There is an ingrowing vascular tuft extending into the medullary cavity of one fragment. There is a number of punctate red areas on the epiphyseal end which suggests a vascularization of the bone.

Microscopical examination. There is practically complete loss of nuclear staining, only those nuclei near the lower layers of the articular cartilage being visible. There are numerous new blood capillaries near the epiphyseal end.

Experiment 24. Duration 93 Days. Dog 14, Growing

Operation. Removed the fourth metacarpal bone of the left fore foot. This was broken in the middle, boiled for 5 minutes, and transplanted to the muscles on the left of the spine.

Microscopical findings. 93 days. The bone was found in the muscles of the back which were adhering firmly to the surface. There was absolutely no evidence of union or attempt at such. The roentgenogram shows the erosion of the distal segment. The density of the bones is about normal (Fig. 13).

Microscopical findings. The bone ends are separated by fibrous tissue and show absolutely no signs of proliferation. In fact they are undergoing absorption. The remainder of the cortex is composed of stainless nuclei except for a small area along one border. At this place there are some nuclei that have a normal structure and staining reaction, suggesting the formation of new bone. It must be again emphasized that this is in a very limited area and is either an example of heterogenous bone, a resistant fixed portion of the original bone or some absorptive rather than a reconstructive process.

Experiment 25. Duration 93 Days. Dog 8, Growing

Operation. Removed the fourth metatarsal bone from the right hind foot. Fractured in the middle, boiled for 5 minutes and then transplanted the two apposed fragments to the right side of the spine.

Gross examination. 93 days. The bones were found encapsulated in the muscles of the back and showed no evidence of union. There was some absorption and the bones appeared smaller than normal. The roentgenogram shows the lack of any signs of union. The density of the bones is about normal. Specimen was saved intact.

Experiment 26. Duration 113 Days. Dog 9, Growing

Operation. Removed the fourth metatarsal bone of the right hind foot and, after boiling and fracturing, the two pieces were transplanted in the muscles of the left side of spine.

Gross examination. 113 days. The two fragments were found in the muscles of the back. There was absolutely no sign of an attempt at union. The roentgenogram (Fig. 14) shows almost an entire absorption of the proximal segment and the lack of union or any evidence of callus.

Microscopical examination. There is no evidence of osseous or cartilaginous callus at the site of the fracture, in fact the bone ends are undergoing absorption. The greater part of the cortical bone is stainless. At two places on the outer surface and one on the inner side of the bone, there are similar areas of new osteoid-looking tissue like that described in Experiment 25. The predominating picture is one of absorption and degeneration of the graft.

SUMMARY ON FRACTURES IN BOILED BONE TRANSPLANTED INTO MUSCLE

There was no sign of cartilaginous or osseous proliferation from the bone at the site of fracture, or any attempt at repair of the fracture in dead bones.

It is considered that this is sufficient proof that the callus in the live bone transplants arises from the osseous elements of the transplant, and that the external fibrous tissue plays no part in forming the osseous part of the callus.

In some of the experiments, small areas that looked like new osseous tissue were noticed. This was never seen at the site of fracture, was of very limited size and irregular in

distribution, and was either an example of heterogenous new bone, some resistant fixed osseous tissue, or possibly was of a destructive rather than of a constructive nature.

ONE-HALF BOILED AND ONE-HALF NORMAL BONE

It has been shown in the previous experiments that live transplanted bone possesses sufficient energy, within its cellular elements, to form a union of a fracture in such a graft. Furthermore, it has been shown that the connective tissue external to the graft does not supply any of the osseous tissue as was examplified in the complete lack of proliferation about fractures in bone that had been boiled. In order to further test this latent energy possessed by the osseous cell of live transplanted bone, it was thought worth while to determine if a live segment of bone would exert any influence on a boiled segment of bone, or make any attempt at repairing this lesion. Such an experiment would also give an opportunity of studying the effect of the tissues and the behavior of live and dead bone transplants under exactly similar conditions.

Two sets of experiments were performed in which, after removal of a metatarsal or metacarpal bone, it was fractured about the center. One half was boiled for from 5 to 15 minutes while the other half was not disturbed. The two segments were then reimplanted in their normal position or the two apposed segments placed in the muscles of the back.

Group V.—Reimplanted One-Half Boiled and One-Half Normal Bone

Experiment 27. Duration 86 Days. Dog 12, Full Grown

Operation. Removed the third metatarsal bone of the left hind foot and divided it about the center into two fragments. The distal half was boiled for about 5 minutes and then reimplanted with the corresponding half in its normal position.

Gross examination. 86 days. The two fragments became separated, and there was no sign of union.

Experiment 28. Duration 113 Days. Dog 9, Growing

Operation. Removed the fourth metacarpal bone from the right fore foot and fractured in the center. Proximal half was boiled 5 minutes and then reimplanted with remaining half in normal position.

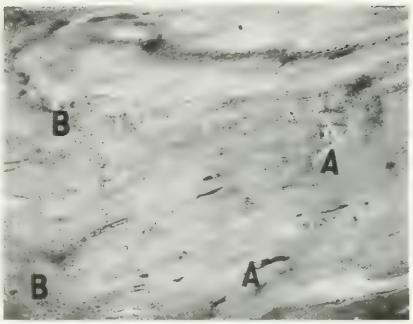

Fig. 18. Experiment 34. Duration 113 days. Photomicrograph of a section through the site of union of a boiled half of a bone with a live half of the same bone, after transplantation to the muscles of the back. Specimen removed at the end of 113 days. *A*, *A*, Dead half of the bone. *B*, *B*, Live half of the bone. There is a definite osseous union between the two fragments of bone. Note the invading finger-like processes of new bone in the dead bone. As there is no other osseous tissue in contact with these pieces of bone, the osteogenetic elements of the live half possess sufficient power of proliferation to form this union. This is considered as being an extreme test for and positive proof of the independent power of growth and repair of osteoblastic tissue after transplantation.

Gross examination. 113 days. The bones have healed in the position in which they were placed. The union at the site of fracture appears to be firm, and there is a moderate amount of external callus. The two fragments are of the same size and do not appear to be connected with the adjoining bones. The roentgenogram (Fig. 15) shows the large callus arising from the distal, normal segment, and evidently invading the boiled half. The line of union is still present as ossification of the callus is incomplete. The boiled proximal fragment is undergoing more extensive absorption than the normal distal half. The medullary cavity of the boiled segment is more distinct than in the normal, most likely due to the lack of regenerative changes. There appears to be a synostosis with the adjoining bones.

Microscopical examination. At the site of fracture there is a large cartilaginous callus which is undergoing calcification and becoming osseous near the bone on either side. This new bone appears to arise from the live normal segment with which it is in more intimate contact. The normal bone is composed of stainable nuclei and shows less evidence of absorption than the boiled segment.

SUMMARY ON ONE-HALF BOILED AND ONE-HALF NORMAL REIMPLANTED BONES

The one positive experiment shows that under favorable conditions, there is sufficient

power of proliferation of the cells of one half of a reimplanted bone to produce sufficient callus, to unite it to the dead remaining half of the bone.

Group VI. Transplanted One-Half Boiled and One-Half Normal Bone to Muscle

Experiment 29. Duration 5 Days. Dog 16, Growing

Operation. Removed the third metacarpal bone from right fore foot and broke it into two parts. The distal half was boiled and then placed in contact with the normal half in the muscles of the right side of the spine.

Gross examination. 5 days. The two bones were found in good alignment with a bloody exudate at site of fracture.

Microscopical examination. The two fragments appear degenerated and are devoid of any signs of proliferation.

Experiment 30. Duration 41 Days. Dog 15, Growing

Operation. Removed the third metacarpal bone from the right fore foot and fractured it in the center. Boiled the distal half for 10 minutes and then placed it in apposition with the normal half in the muscles of the left side of the spine.

Gross examination. 41 days. The two fragments were found to have separated. The distal boiled half was larger but more friable than the proximal half. The ends of the fragments are pointed and show no gross evidence of proliferation.

Microscopical examination. There is some cartilaginous and osteoid callus at the end of the live fragment, which does not completely bridge the gap between it and the boiled segment. There is no evidence of proliferation from the boiled bone.

Experiment 31. Duration 41 Days. Dog 15, Growing

Operation. Removed the fourth metacarpal bone from the right fore foot, and after fracturing in the center, boiled the proximal one-half. The two halves were then placed end to end and transplanted into the muscles on the right side of the spine.

Macroscopical examination. The fragments were found in good position in the muscle. There appears to be some callus at the site of fracture, and at least a partial union.

Microscopical examination. There is a mass of new callus extending from the live segment toward the boiled bone. The boiled bone is devoid of normal nuclei, and there is no sign of proliferation.

Experiment 32. Duration 86 Days. Dog 12, Full Grown

Operation. Removed the fourth metatarsal bone from the left hind foot and fractured it in the middle. The proximal half was put into boiling water for 5 minutes. The boiled and normal halves were then placed end-to-end in the muscles on the left side of the spine.

Gross examination. 86 days. The bone fragments were found in the muscle. There was absolutely no sign of union.

Experiment 33. Duration 95 Days. Dog 13, Full Grown

Operation. Removed the fourth metatarsal bone from the right hind foot and after fracturing in the center, boiled the proximal segment for 5 minutes. The endosteum was curretted out of the other half. Then the two halves were placed together and transplanted to the muscles on the right side of the spine.

Gross examination. 95 days. The bones were found in the muscles of the back without any signs of union. The boiled fragment is smaller than the normal and appears to have undergone more absorption. The roentgenogram (Fig. 16) shows the marked absorption of the boiled fragment and a possible attempt at proliferation at the end of the normal segment.

Microscopical examination. There is considerable new osteoid and cartilaginous tissue about the end of the live fragment. There is absolutely no sign of proliferation about the dead fragment, in fact the picture is one of rapid absorption.

Experiment 34. Duration 113 Days. Dog 9, Growing

Operation. The third metacarpal bone of the right fore foot was removed and fractured in the middle. Boiled the proximal half for 5 minutes and after putting the two fragments together they were transplanted to the muscles on the right side of the spine.

Gross examination. 113 days. The bones have healed nicely in place. There appears to be definite union between the two fragments. The distal one-half is larger than the proximal boiled half, and is evidently more resistant. The roentgenogram (Fig. 17) shows definite osseous union at the site of fracture. The boiled half has undergone more extensive absorption than the live half, and is less dense.

Microscopical examination. A section through the bone at the site of union shows that it is entirely osseous (Fig. 18). This remarkable picture shows the live bone on one side with its finger-like projecting processes of new bone penetrating the dead boiled segment. With such clear evidence of independent activity, under such adverse conditions, it does not seem possible that there could exist any further doubt as to the independent reparative powers of

the osteogenetic cells of the transplant. There is absolutely no sign of any changes in the surrounding connective tissue. There is definite evidence of absorption of the live bone as well as of the boiled bone. There are several areas in the boiled bone that look like new osseous tissue of the heterogenous type, previously described in the experiments on boiled bone.

SUMMARY ON ONE-HALF BOILED AND ONE-HALF NORMAL BONE TRANSPLANTED INTO MUSCLE

Before considering the results of this series of experiments it is important to bear in mind the nature of the experiment. In the first place the bones are buried in muscle and thereby removed from any possible contact with other osseous tissue. In the second place they are not subjected to normal functional stimulation. In the third place one fragment has been killed by boiling. Even after the astonishing resulting union of two live segments under similar conditions, one at the most would hardly expect more than a slight proliferation at the end of the live segment. Now, when we find that after 113 days in one experiment a definite union of a live with a dead segment occurred, a considerable importance must be accredited to this independent power of growth possessed by the osteoblastic cells of bone after transplantation. In one other experiment there was beginning union, while in the three remaining observations in which the time was sufficient, there was a failure of complete healing of the fracture, but definite evidence of proliferation from the live segment in an endeavor to bridge the gap.

The live segment was more resistant to absorption than the dead half.

General Summary

1. Fractures in entire free bone transplants either when reimplanted or transplanted to the muscles of the back united in a similar manner to a fracture in a bone under normal conditions. The callus arose from the active osteoblastic cells of the transplant itself, without the aid of any other osseous tissue. In the removal of the bone, as the entire metacarpal or metatarsal, one necessarily destroys its blood supply. As the healing of the fractures takes place in spite of this destruction of the vascular supply, it seems as though one could not include injury to the blood supply as a cause of non-union in an ordinary fracture, where conditions are much more favorable for healing than in a transplant, especially when buried in muscle. The explanation of the cause of non-union, outside of those cases of malalignment and interposition of fibrous or muscular tissue between the bone ends, is most likely due to some deficiency of necessary chemical elements or lack of certain physiological stimuli.

2. Fractures in boiled bones, either when reimplanted or transplanted to the muscles of the back, showed no evidence of union or proliferation about the bone ends. Therefore, it cannot be contended that the callus-forming tissue arose outside of the bone of the transplants, as there was an equal opportunity for such an origin in the boiled as in the live bone. There was never any evidence of new bone forming in the boiled bone, except for an occasional very limited area in which the cells appeared fairly normal, which was possibly due to a better fixation by heat or real example of heterogenous bone formation. The boiled bone showed more evidence of absorption than the live bone after transplantation.

3. Fractures in transplanted bones in which one-half is boiled and the other half allowed to remain in its normal condition, either reimplanted or buried in the muscles of the back, will unite. This means that there is sufficient power in the osteogenetic cells of the live half to bridge the fracture gap and penetrate the dead fragment, thereby welding the live transplant to the dead transplanted bone.

4. It might be said, that just as nature abhors a vacuum so does it abhor a fracture and, therefore, makes every effort to repair such a lesion, under all conditions, in a definite, orderly, and purposeful manner.

CONCLUSIONS

1. Fractures in transplanted bone, even when buried in muscle, united firmly and in a similar manner to a fracture under normal conditions.

2. Fractures in boiled transplanted bone never united nor showed any signs of pro-

liferation or attempt at repair. Occasionally a small area resembling new bone was noticed on the surface, which bore no relation to the fracture and was possibly of metaplastic origin.

3. Fractures in transplanted bone, in which one-half was boiled and the other half was alive, even when buried in muscle under favorable conditions united. It is believed that this is the crucial test of the independent, inherent osteogenetic power of the cells of a transplanted piece of bone, and establishes beyond doubt the proof of this independency and furthermore shows an additional reparative property of these same osteoblastic cells.

(I wish to express my indebtedness to Professor Blaisdell for the privileges of the laboratory which were granted to me during this experimental work.)

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THE EFFICIENT SURGEON[1]

By RAFFAELE BASTIANELLI, M.D., Rome, Italy

I RECALL with great pleasure one evening 4 years ago when I had the great honor of receiving the diploma of fellow of this College from the hands of Dr. W. J. Mayo. I do not know really why this new honor of delivering the Fellowship Address should have been conferred upon me, unless because your Director General knew that I have infinite spiritual ties and sympathies not only with the prosperity of the College but with the great ideals to which it aspires. This makes me feel that I am not a stranger among you, and gives me the greatest confidence in addressing you—which I am doing out of the fullness of my heart.

I had prepared a rather elaborate study on the statutes of some old Italian colleges, especially of the famous Medical School of Salernum, but being here among you I feel that your spirit is in the present, and that you are looking with keen eyes toward the future. So it seems to me the dust of the centuries is better left intact on the venerable shelves of the past.

Your institution in 9 years has accomplished gigantic results, and it is running at such a speed, that it is justifiable if your attention is dedicated to the immediate present, if not completely to the future. When I consider the greatness of such an institution capable of uniting both North and South America, the power it has obtained—a power achieved not only because of the number of fellows, because of its wealth, and its energy, but because of the noble aims to which you aspire—I am astonished and feel as if I were suddenly brought into the fairy land of human ideals. For, there is no doubt, that human ideals are better achieved by our profession than by any other on earth. In 9 years the College has already attained many of its purposes or ideals. I need not remind you of the work of the hospital standardization department which reports 83 per cent of the hospitals meeting the minimum standard of the College—a really incredible result—the abolition of the fee splitting, and other features destined to raise the medical standard higher than ever.

The beauty and the comfort of a hospital are great things. The laboratories, their equipment, the funds to keep them up, certainly make for great progress and give incredible facilities to the student, but what would all that mean if there were not present, spirits capable to give life to those inanimate things? The next project of the College will certainly be this: to raise the surgeons to a greater efficiency, and, why not, to try to create a standard surgeon?

This question is so deeply connected with that of the medical education, that unless you confront the one, you will not be in position to look even adequately at the other. For instance, the College elects its members after careful consideration: let me say that surely the selection will include the best. However, the College must select out of the material at its disposal. Is this material the best that medical education can produce? What can the College do to make it the best, and what can it do for the many who are not members?

These outsiders have a right to live, a right to exercise their profession, and more than that, they have the right to feel that there is a human, kind, supporting hand given to them with the best Christian spirit, to raise them, to make them better. None of us who has a more privileged position, can think of leaving in the struggle without help other colleagues who have families to support and patients to treat. The College, I am sure, will take care of such men, too, for they represent the lost sheep which the good shepherd should like more than the ninety-nine he sees around him.

The demand for doctors, in a large country like this, is enormous, and the ones who are scattered far away in remote sections should not be neglected, for they are fighting great struggles single handed. Did they start with the best equipment for the fight? Could they keep such equipment up to date as is necessary? Let me say that I have infinite sympathy for the country doctors and for the most humble of them, for I know their life well. Whether they be Fellows of this College or not, let me send to them the most hearty wishes, for I feel like a true brother to them. And the best wish is, that some day there will not be Fellows of the College and outsiders, but all will and must belong to it or not exist. And then perhaps there will be only one College, which, uniting surgeons, physicians, and specialists, will call itself the American Medical College. Such a great universal institution would not only be capable of taking care of all the medical men of this country, but perhaps look after the welfare of all the medical men of the world in communion with the Colleges of all the world, and would have the best authority to handle, not from the point of view of the surgeons, but of every medical man, the problem of medical education, better than many separate Colleges could do.

After all I am sure the true question is this: The good surgeon is the good medical man —and you will have good surgeons only if you can have good medical men. Certainly he must have a generous heart and a well-balanced brain, like that of any medical man, only he must have dexterous hands too, and the combination of the three qualities is not always easy to find. Though the hands be less dexterous or even not brilliant, they must be safe, and the very beginning of safety is knowledge.

How can we give this knowledge to the students during their school years, and how after graduation?

There is science and practice in medicine, and it would be just as unjust if the one or the other should prevail. Since the future doctor is the man who has to treat sick people, it is clear that all our efforts should be directed toward providing him with adequate practice guided by science. Science and practice in the school should aim not to fill the minds with innumerable facts or with innumerable observations, but with the principles themselves. Let me summarize them: the teaching of science to a student means the giving to him of such a scientific habitude of mind that he will feel the power of the science all through his life, so that he may see everything through it and with it, and apply it to the study of patients, and do nothing without it. The principles of practice could be summarized as follows: the teaching of students in the use of their fingers, their eyes, their ears; in learning how to observe and how to develop the habit of thinking.

Observation is a very rare quality: in the one student it is inborn, powerful, always active, leading to discoveries; in an other it is a hibernating faculty which can be beautifully developed by constant training, and even if not reaching the height of the inborn quality, may be made such as to enable every student leaving the school to be ready to use it in every occasion, and never to take any chance, but always be capable, as you say, to stop, look, and listen. Have you ever considered

the importance of these three words, and especially of the first? Take a chair if you are in a hurry, sit near the patient and you will be at once capable to see. And to listen to a patient, is it not the most difficult thing?

But it will be less difficult for the student if he learns by example from his teacher, who sits down and listens. Even in the most feverish chattering of the neurotic woman or in the lamentation of a hypochondriac, there is much to be listened to; I am deeply impressed by this sentence: the patient is always right.

Now the medical schools provide the students with magnificent laboratories, with men of true science, with instructors, patient and efficient. There is no excuse for us in the future: either the new generation will be superior, or our teaching is not right. The first thing to avoid in the school, if we are to escape reproaches, is that we must stop splitting up the big tree into smaller and smaller branches, lest the connections with the tree shall be lost. I speak of obligatory teaching, not of facultative teaching, and less of practice. For I believe we have to let everybody be free to practice whatever part of medicine and surgery he wants, and every school free to enlarge facultative teachings: but we should never compel the student to hear of all those things separately: he should see them presented by the general clinical teacher under one heading and in their real relation with the whole of the patient, not as diseases pertaining to a separate detached portion of the body. Perhaps anatomy and physiology, as our honorable president thinks and teaches, should always be connected with the human sick body during the school years if we want them not to be crude and dry memory efforts, but living and inspiring foundations for clinical practice.

Besides this general question, we could discuss at length the single matters to be taught, such as the place to give to pathological physiology versus pathological anatomy, the importance of laboratory work, the necessity of not believing that the only surgeon will be the research surgeon, and so many other details. Let me say that I believe deeply in the necessity that the student should be trained to see the anatomical structural changes in the organs he is examining clinically, as if he had them in his hands: whatever may be the importance of thinking physiologically, the most the average surgeon needs is to recognize anatomical lessons, for he is the pathologist of the living.

To encourage the students to do research work is commendable. But as it would be useless to give music lessons to every boy, so it is of research if extended to students in general. The man who has the impulse of research will find his way even in the most adverse circumstances, and even in the most desolate surroundings, like Magendie, Claude Bernard experimenting in a cave, Pasteur doing all his early work in one room which he would clean as he had to clean all his glasses and instruments.

The research mania is still worse when it has the scope of creating pseudo-scientific papers and futile experiments, many of them unhappily as a means of advertising. The average surgeon will better dedicate his time to other studies unless an interior force pushes him to the research laboratory. After all, no laboratory, no monumental building will change what the thousands of years have proved to be true, that only few men possess the lighting flame of discovery. Their influence lasts for years more or less, during which all the others are working along their ideas: let them be called contributors, modifiers, elaborators, they are a crowd destined to disappear. Humanity looks at the high peaks, and even if now and then a lower mountain may attract the attention, certainly the sun will shine until the last minute only on the high snow-clad summits.

I do not wish you to interpret that I am diminishing the importance of the research work. Quite on the contrary: for no real progress is made unless based on scientific foundations even remote and indirect. I mean only to caution against the tendency to urge the whole mass of students to attempt laboratory research rather than clinical investigation, as if they could do something good. That is impossible. But the clinician certainly can and should inspire research

work, and be able to go into it if necessary, for generally the clinical investigations reach a dead point after a while, and cannot be animated but for the life coming from science. Research for clinical purposes, and the pure science cannot be put on the same level: every student should get well acquainted with the first, and only a few with the latter.

And now let us take the young man who has the habit of thinking scientifically, and let us teach him how science works at the patient's bed. He will soon learn the importance of that, if we can train him first to do all the minor work of medicine and surgery, in its least detail, say, as if he should be a trained nurse. Let us teach him by experience on the living how a drug does work in the pathological conditions of the human body, let us teach him physiology and anatomy under the light of the morbid condition of the single individual and of the treatment, let the teacher inspire him with broad views of subjects from a general point, and soon he will be able to understand the major problems and to think of them with his own brain. To reach that scope the American College could well take steps. Is such teaching now materially sufficiently done? I mean, inasmuch as there are beds and the instructors provided for each student. And as I suppose, if it is numerically not enough, do you think that it would be good to enlarge the clinical department of the school so that one man would lead such a large institution, or do you think that it would be far better to extend to other men, having charge of first-rate hospitals, the privilege of teaching? What a spirit of noble competition would be created and how much easier, inexpensive, and liberal it would be: for it would train properly so many more doctors, and a smaller number of them would need postgraduate work, if they were obliged to enter directly into practice.

Next to the student question comes the one of the future surgeon. Even the best teaching during the school years cannot create a good general surgeon. "To frequent societies, to visit clinics and libraries, to own valuable instruments or valuable books, to publish papers in journals, does not contribute in the least to the comfort of the sick," said Baglivi, an illustrious Italian physician of old times.

At the present state of our art and science nobody can be allowed to be a self-made man in surgery: he must necessarily have the inheritance from his predecessors to thrive on and to add to. This is only possible by compelling anybody who will be only surgeon to enter into hospitals and clinics, and to serve for a certain period of time and to give a final proof of his capabilities. It seems hard to have to stand, later in life, such an ordeal, but I believe it extremely necessary if we are to avoid the unconscientious surgeon tackling difficult cases only because he has acquired, say, the instruments Dr. X. is using, or the catgut and needles seen in Dr. Y's clinic. The general practitioner, the one who is usually confronted with surgical emergencies, should know how to recognize them first, and to attend to them only if immediately necessary. For if time allows he had better send them to safer hands.

In thinking of the position of the general practitioner I am reminded of the sixteenth century statute of an Italian town which said that "people not belonging to the College and wanting to practice surgery, either being citizens or foreigners, should be diligently examined by the College, who will give to him as much authority to practise as the College will recognize him capable. But in wounds, ulcers, and dangerous apostematas he will be obliged to join a fellow doctor."

This will never be possible in our times and with our degrees. To promote consultations, to persuade the practitioners that it is their deep duty never to leave a responsible case without the help of a colleague if available, and that help will not be a diminution of their authority, can be a good aim of the College. I believe that the time will come when the College will be able to enforce the rule that every general practitioner should have, after a certain time, say for example, 3 years, a course of at least 2 months' duration, in which he could see the new things, remember and review the old ones and have practical instruction in the wards in the operative theater. Perhaps the day will come when also the general surgeon who has not a

hospital appointment may be compelled to have a course after so many years. All these suggestions seem to me appropriate to the circumstances and perhaps worth some consideration.

The world owes much to America in matter of surgery. Let us hope that the men of the next generation may say that America created the standard surgeon.

I have great faith in the future of the surgeon and am even deeply persuaded that the man endowed with a brain full of initiative and scientific capabilities, with a generous heart and with wonderful hands will be always an exception, the average surgeon will appear as a man capable of performing his duties not only with his hands but with full knowledge of his responsibilities, and what is more important with complete conscience of his possibilities.

I would have liked very much to project some diplomas of the Salernum school dating from the middle of the sixteenth and seventeenth century, and to illustrate them in completing my address. As it is not possible to do this, let me quote only how one of the texts ended: "We Rector and Fellows of the College have with solemn ritual attended to his Degree: we have put in his hands a closed book and then opened it, on his finger the ring, on his head the crown, and each one of us having as is customary kissed him in the church of Saint Catherine, we have accompanied him home with our best wishes." Do you remember how Longfellow rendered it?

> Having faithfully promised these,
> His head is crowned with a laurel crown;
> A kiss on his cheek, a ring on his hand
> The Magister Artium et Physices
> Goes forth from the school like a lord of the land.

We have no more of those symbolic formalities. Nobody has put the book in your hands, neither the ring on your finger, and certainly not the crown on your heads. *But you have made some promises!*

Let me wish to all of you, new and old Fellows, that at the end of your career, you may look back at those promises and see that you have fulfilled them, and that, in the last days, you will smile quietly, for you will feel that all your life is being crowned in that moment, by a better and a stronger power than that of any College of Surgeons, than that of any other power on the earth—by the power of your conscience.

THE PATHOLOGICAL ANATOMY OF "AUTOINTOXICATIONS" IN PREGNANCY AND CHILDBIRTH

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IN pregnancy and during childbirth there not infrequently arise severe and even fatal diseases the pathogenesis of which is obscure and disputed. It may concern convulsions, icterus and albuminuria, severe vomiting, and neuritis as well as cutaneous symptoms. The conception of the nature of these conditions varies greatly. Puerperal eclampsia has long been regarded as an intoxication, but concerning the nature of vomiting of pregnancy, neuritis, etc. there is great difference of opinion. The fact that these conditions seem to be related through transitional forms may be said to point to a common etiology, and the anatomical changes in these conditions also indicate that they are related, even if subject to manifold variations. In the course of years I have had occasion to make many postmortem examinations of patients from the gynecological clinic of the Rikshospital (Professor Brandt) who have died with symptoms of the kind in question, and I have thought that it might be of interest to review this material particularly from the anatomical point of view.

GROUP I.—PUERPERAL ECLAMPSIA

The pathological anatomy of puerperal eclampsia is quite typical and may be described briefly as follows: The kidneys are acutely and violently degenerated, being pale, yellowish white in color, but as a rule there is no acute or chronic nephritis except as occasional complications. The degeneration may vary in degree; sometimes there may be hæmorrhages, oftener one meets with necrotic, infarct-like areas and also small hyaline thrombi in the vessels. The pelvis and ureters are, as a rule, free from changes. Usually the liver shows the most characteristic and, one might say, almost pathognomonic changes — it is degenerated, soft and flabby, pale, with an icteric tinge, with transitions toward acute yellow atrophy. Perhaps the most characteristic feature is the so-called hæmorrhagic infarcts, which consist of sharply circumscribed, irregular, usually red areas on the surface of the liver that extend into the substance for a distance, and are infiltrated with blood in places. Microscopically such infarcts show an extensive necrosis or degeneration of the liver cells, dilatation of the portal capillaries and more or less hæmorrhagic infiltration; the capillaries may be thrombotic and filled with hyaline masses, the contours of red corpuscles being perhaps recognizable. Such changes in the liver may vary greatly in intensity and do not correspond to the intensity of the convulsions.

The spleen does not show any special changes; the lungs may be hyperæmic and œdematous, sometimes showing small hæmorrhages, and occasionally liver cells and giant cells are found in the small blood vessels; in the central nervous system may be found punctiform hæmorrhages and occasionally large fatal cerebral hæmorrhages occur even when the blood vessels appear to be normal; the heart muscle may be degenerated with subepicardial hæmorrhages, and the blood often is laked more or less; in the genital organs the conditions as a rule are normal without signs of infection.

Some stress has been placed on the emboli of cells found in different organs; liver cells may be found in the blood, the myocardial and pulmonary capillaries, also giant cells from the placenta and even chorionic villi.

While the anatomical picture, especially the hæmorrhagic infarcts in the liver in connection with the degeneration of the kidneys, is more or less pathognomonic, typical eclampsia may be associated with rather indefinite and not well-marked degenerative changes which resemble those found in other forms of so-called autointoxication, and such cases (without convulsions), in turn, may be associated with anatomical changes such as are seen in typical eclampsia. A few illustrative instances follow.

GROUP 2.—ECLAMPSIA WITHOUT CHARACTERISTIC ANATOMICAL CHANGES

CASE 1.—Primipara, age 27, gave birth to full-term child whereupon an eclamptic attack developed followed at intervals of 3 to 4 hours of in all 25 definite attacks of tonic and clonic convulsions with deep coma. Chloral, morphine, and blood letting had no effect. Death occurred after about 48 hours with rising temperature. The lungs showed a double bronchopneumonia; the heart seemed rather large, flabby, with subepicardial hæmorrhages, muscle yellowish; the uterus, characteristic of the puerperal state, was otherwise free from any changes, but there were thrombi in the internal spermatic vein, pudendal and uterine plexuses; the spleen was soft and enlarged. The kidneys were large, smooth, with swollen cortex with indistinct markings, pelvis normal, and microscopically there was parenchymatous degeneration in the convoluted and straight tubules, but no nephritis. The liver weighed 1850 grams; pale yellowish white in color and of the usual consistency, the surface showing only one or two small rather indefinite hæmorrhagic infarcts, and microscopically the epithelium was markedly degenerated in places, but there were no hæmorrhages. There were no changes in the brain; leptomeninges injected and œdematous.

Summary. In this case the principal changes were degeneration of the liver and kidney with poorly developed hæmorrhagic infarcts in the liver. The alterations in the liver were insignificant in comparison with the violence of the eclamptic symptoms.

CASE 2. A woman, age 20, died of eclampsia having had diplopia and headache for a few days. At the autopsy the uterus contained a fetus about 30 weeks old. The liver weighed 1490 grams, surface smooth and shining, pale reddish brown in color; numerous capsular hæmorrhages not extending into the tissue of the liver, which microscopically appeared to be quite normal in structure except that the portal branches were greatly congested, but there were no thrombi and no hæmorrhagic infarcts, the cells adjacent to the veins being somewhat degenerated, and evidently an œdema had developed about the veins. Heart normal; spleen small. Left kidney small with a scar on the surface, the cortex broad and swollen; right kidney weighed 160 grams, smooth and shining on the surface, cortex pale yellowish brown, 8 to 10 millimeters in width, with distinct markings; microscopically there was some hyperæmia and marked degeneration of the epithelium in places in the convoluted as well as the straight tubules, but no nephritis. Other organs were normal except that in one adrenal were a few small hæmorrhages with a little necrosis in the cortex.

Summary. This was a typical eclampsia developing in pregnancy, but without the characteristic anatomical changes as there was found only an acute degeneration in the liver and kidneys as well as necrosis and hæmorrhages in one adrenal. There were no hæmorrhagic infarcts in the liver, but the dilated vessels and the early œdema may be regarded as a beginning infarction.

GROUP 3.—INTOXICATIONS WITHOUT CONVULSIONS BUT WITH THE ANATOMICAL CHANGES OF ECLAMPSIA

CASE 3. A primipara, age 41, expecting confinement in March, 1921, entered the clinic March 8; she was pale, but fully conscious, with albumin and pus in the urine; on the same evening she gave birth to a dead fetus weighing 1500 grams; there was a hæmorrhage of about 500 grams and the placenta was delivered easily soon afterward; the patient died suddenly next morning with stertorous breathing.

In the left frontal lobe was a large hæmorrhage, containing a clot about 12 centimeters long, the gyri were flattened, the sulci small, but otherwise the brain was normal. No icterus; no gas emboli in the heart and no emboli in the lungs; the heart weighed 290 grams, there were some hæmorrhages under the endocardium of the left ventricle, and along the line of closure of the mitral valve were small warty excrescences containing gram-positive diplococci; the respiratory organs showed no changes; there were no signs of any infection in the genitalia; the spleen was small and weighed 120 grams. The kidneys weighed 310 grams, were smooth on the surface and pale yellow in color, the cortical markings were distinct; microscopically the only change was degeneration of the renal epithelium, especially in the convoluted tubules. The liver weighed 1770 grams, was smooth on its surface. The larger part of surface of right lobe and here and there of the left lobe presented large, intensely red areas or irregular spots, but the redness did not go down very much into the substance which was pale, yellowish white, with fairly typical markings, and microscopically there was found here and there rosette like necrotic areas in the periphery of a series of adjacent acini, the necrotic districts being sharply defined, irregular in outline, like a network with small spaces, the bile capillaries in these areas being widened and filled with blood or a red homogeneous material, while surrounding the necrotic foci the liver tissue was degenerated and filled with fat and pigment granules. The stomach and intestines showed no changes.

Summary. The lesions correspond well to the picture of eclampsia parturientium, especially as regards the liver, and the cerebral hæmorrhage was such as may occur in eclampsia and cause death quickly, but clinically there were no convulsions, consequently no eclampsia.

CASE 4. A primipara, age 21, entered the clinic February 22, 1922, in the fifth or sixth month of pregnancy. She had had headache, œdema of the legs and black shadows before the eyes for some days before and about 2 days before she had a convulsive

attack. The temperature was normal; eye grounds normal; the urine contained albumin and pus, hyaline casts and red cells; and the legs were œdematous; blood urea 0.4 per cent, blood pressure increased. March 30 a girl about 30 weeks old was born; about 800 cubic centimeters of blood was lost and some 30 hours later the patient became pale, restless, more or less collapsed. In spite of camphor and caffein the general condition remained unsatisfactory during the subsequent days when vomiting set in, the vomitus containing blood; there now appeared also attacks of dyspnœa, but the senses remained clear and there were no convulsions, gradually the dyspnœa became worse and death occurred April 1.

Postmortem the heart, which weighed 235 grams, presented numerous subendocardial and subepicardial hæmorrhages, the muscle being pale; except for subpleural hæmorrhages and some œdema, the lungs were normal; thyroid and parathyroid glands normal; spleen small, weight 55 grams. Liver weighed 1470 grams, the surface was highly mottled; the apex of the left lobe presented an elevated area, 8 by 6 centimeters, quite firm, pale yellow with red specks and areas, sharply defined but without definite hæmorrhagic infiltration, there being also smaller yellowish areas elsewhere in the left lobe; along the right border of the right lobe was an infarct-like district of the same appearance as in the left lobe while the entire under surface of the right lobe showed many small infarct-like districts. The pancreas was normal, weight 67 grams. Kidneys weighed 280 grams, capsules free, surface yellowish, cortex narrow but markings distinct, pelvis and ureters normal, but microscopically the urinary tubules were everywhere filled with a granular mass containing epithelial cells and leucocytes, and fat stains showed much fat in the epithelium throughout the kidneys as well as in the endothelial cells. Adrenals normal; some hæmorrhagic erosions along the minor curvature of the stomach; intestines normal. The uterus and other genital organs showed no signs of infection or unusual appearances and the brain and its membranes looked normal. Microscopically the infarct-like areas in the liver showed a complete necrosis of numerous acini in some places and a partial necrosis in others, the necrotic epithelium being filled with small, fat granules and bile pigment, while at the periphery there was either congestion or hæmorrhagic infiltration with leucocytic accumulation; there were no thrombi or emboli in the small branches of the portal vein and there was no fibrin precipitation at the peripheries of the acini; in the larger branches of the portal vein the coagula contained numerous leucocytes filled with fat granules.

The child lived 9 days and weighed 1270 grams; there were numerous rather extensive hæmorrhages in the lungs and over the surface of the heart and kidneys.

Summary. It is noteworthy that except for the marked fatty degeneration, the kidneys were normal, while the liver in every way corresponded with the liver usually seen in eclampsia. It is true that the patient had a convulsion early in pregnancy but death occurred under a different picture than that of eclampsia.

Case 5. A woman, age 51, who had had six children, suffered nausea, vomiting and headache toward the end of the second month of pregnancy; mental symptoms supervened, the vomiting increased and at the end of the third month a hydatid mole was removed with the placenta, followed by death 24 hours later. The kidneys were pale, yellow white and degenerated, and the liver, which weighed 1080 grams showed numerous, small, sharply defined, red spots under the capsule, the cut surface being yellowish brown and the parenchyma friable. Microscopically there were fat changes in the renal epithelium, the nuclei of which stained poorly, the stroma and glomeruli being normal; the liver showed no inflammatory changes, marked fatty change in the liver cells, which also contained green pigment, congestion of the portal capillaries at the periphery of the acini with hæmorrhagic extravasations and some necrosis of liver cells. At the placental site were the typical structures of hydatid mole, but no signs of chorio-epithelioma.

Summary. The appearance of the liver resembled somewhat that in eclampsia and the case forms a transition between eclampsia and other intoxications so far as the anatomical changes are concerned.

Here may be mentioned a case illustrating eclampsia-like conditions in pregnancy, but with no relation to true eclampsia or other similar intoxications.

Case 6. A woman, age 39, was attacked by convulsions in the third month of pregnancy, which occurred again at different intervals; when she entered the clinic in the tenth month she was unconscious and convulsions set in, which became more and more severe, death occurring in coma. There was a right facial paralysis and the positive Wassermann reaction of the blood as well as the presence of mononuclear cells in the arachnoid fluid led to the suspicion that cerebral syphilis was present. The postmortem examination showed syphilitic aortitis, granular ependymitis and a microscopically typical meningo-encephalitis; the heart muscle, the liver, and the kidneys showed some degeneration. It would be most reasonable to ascribe the convulsions in this case to the meningo-encephalitis.

Group 4.—Autointoxication in pregnancy and childbirth that clinically appears as renal disease and anatomically as renal degeneration

Case 7. Woman, age 38, developed œdema and albuminuria in the last month of the second pregnancy. When she entered the clinic she was pale,

cyanotic, and had high blood pressure and severe albuminuria. Cæsarean section was made (Dr. Sunde) and full-time twins were delivered; the cyanosis and œdema increased and the patient died the following day. The postmortem examination showed, as the main changes, some enlargement of the kidneys, which weighed 350 grams, and were pale yellowish white, soft, with indistinct markings; microscopically the epithelium, especially in the convoluted tubules, was markedly degenerated and contained many fat granules, nuclei not demonstrable, but the glomeruli were normal and there were no signs of inflammation in the kidney. The liver was not enlarged, was rather soft, and microscopically there was a good deal of fat in the cells in the periphery of the acini.

Summary. The degenerative changes in this case must be regarded as the expression of an "autointoxication"; it is noteworthy that the renal degeneration seemed to predominate clinically as well as anatomically.

GROUP 5.—AUTOINTOXICATION IN PREGNANCY AND CHILDBIRTH IN WHICH DEGENERATION OF THE LIVER PREDOMINATED

CASE 8. Primipara, 37 years old, entered the clinic in the eighth month after having had headache and vomiting for about 8 days. She seemed confused, there was mild icterus present, also cyanosis, and as these symptoms all increased the head was perforated and the fetus extracted. Complete anuria developed and she died the following day. The kidneys were large, weighing 380 grams, and soft, the cortex pale; microscopically there were no inflammatory changes but a marked albuminous degeneration with but little fat. The liver was small, weighed 1410 grams, was soft, markings indistinct, color throughout pale yellow. Microscopically the liver cells were degenerated, but there were no inflammatory changes. In the right ventricle were rather loose thrombi, and in the lungs were emboli with some hæmorrhage in the corresponding tissues but no definite infarcts. There was some icterus.

Summary. In this case the liver was the seat of the most marked changes.

GROUP 6.—HYPEREMESIS GRAVIDARUM

CASE 9. Primipara, age 25, suffered from vomiting since about the second month and entered the clinic in the third month on account of continued severe vomiting; a few days later she became almost blind and the uterus was emptied, but the condition became worse and she died 48 hours later. The postmortem examination showed no special changes in the heart, spleen, or central nervous system; the liver was rather yellowish and somewhat degenerated, but there were no hæmorrhages or infarcts and the microscopic sections showed no inflammatory changes, no necrosis or hæmorrhages, but some fat in the liver cells the nuclei of which stained well; the kidneys showed a marked pale yellow, degenerated and swollen cortex, and under the microscope the epithelium of the convoluted tubules was changed into a structureless mass without any stainable nuclei, but there were no signs of acute or chronic nephritis.

Summary. A pronounced case of vomiting of pregnancy with so marked degeneration in the kidneys that it cannot be explained merely as the result of inanition.

CASE 10. Woman, 22 years old, entered the medical clinic on account of "dyspepsia" and vomiting; the vomiting persisted until she died about 3 months later; the day before she died, a vaginal hæmorrhage appeared and a fetus 12 centimeters long was expelled. The postmortem examination showed an extensive parenchymatous degeneration in the liver and kidneys while in the stomach there was nothing abnormal to be seen and no ulcer; the liver weighed 1250 grams, was yellowish in color, soft, no hæmorrhages or infarcts, and microscopically there was found a severe fatty change; the kidneys were pale yellow, soft, with indistinct markings and severe degeneration of the cortex but no inflammation.

Summary. Undoubtedly this was a case of vomiting of pregnancy with severe degeneration in the liver and kidneys.

GROUP 7.—AUTOINTOXICATION IN PREGNANCY AND CHILDBIRTH WITH THE PREDOMINANCY OF NERVOUS SYMPTOMS

This may concern neuritis, especially of the optic nerve with blindness, due to degeneration of the nerve rather than a real neuritis. Schioetz[1] has emphasized the frequency of papilloretinitis in pregnancy, particularly in women, who have chronic nephritis but also in women without any definite clinical signs of nephritis, and he has emphasized too the occurrence of amaurosis without anything abnormal in the eye grounds either ophthalmoscopically or anatomically; at times detachment of the retina, œdema, hæmorrhages were found by him, however, in eclampsia and also in "threatened eclampsia," that is to say in intoxications without eclampsia, the condition in which we are interested especially. Of other nervous symptoms may be mentioned the frequent neuralgic pains, polyneuritic phenomena, chorea, etc. Nervous disturbances occur especially in eclampsia and excessive vomiting of pregnancy, and the anatomical substratum for these disturbances is not well known and has not been given

much study. In addition we have different forms of mental disturbances, such as puerperal mania, confusions, etc., that also may be looked upon as manifestations of intoxications, and in which may be found degenerative conditions in the liver and kidneys. Such cases are of medicolegal interest because the patients may conceal the birth and kill the fetus while mentally disturbed and really not responsible for their actions.

DISCUSSION

The most important anatomical changes in these conditions are degenerations in the liver and kidneys. As a rule these changes are pronounced, without being specifically characteristic, being present in cases of eclampsia both those that do not have infarcts (see Group 2) as well as those that have more or less well-marked infarcts in the liver. Cases 3, 4 and 5 (Group 3) showed hæmorrhagic infarcts, but no eclampsia, and on the other hand Case 2 is a typical case of eclampsia but with indications only of beginning infarct formation in the liver, the other changes being of the same kind as seen in other forms of toxicosis. Furthermore there may be hæmorrhages in different organs just as in eclampsia; in Case 3 there was a cerebral hæmorrhage quite similar to that not infrequently found in eclampsia. Case 2 is interesting because of the necroses and hæmorrhages in the adrenals, the case being one of eclampsia without infarcts.

At times the changes in the kidneys may dominate the picture (Case 7, Group 4), while at other times (Case 8, Group 5), the liver degeneration may be the most pronounced lesion. The cases of excessive vomiting of pregnancy (Cases 9 and 10) are of special interest; degeneration of the kidneys was the most marked in Case 9, but both liver and kidneys were involved and there were present the symptoms of amaurosis without retinitis. In a few cases of hyperemesis, acute yellow atrophy of the liver has occurred.

Viewed as a whole the cases present all possible transitions from genuine eclampsia, with or without characteristic anatomical changes, to the different other groupings. The anatomical picture in the different forms to a certain degree is similar, even if there are many variations, and it lies near at hand to think of all these cases as similar in etiology and like eclampsia as due to autointoxication. In this connection it is of interest to recall the similarity of the cases under discussion with phosphorus, arsenic, and mushroom poisonings.

The syndromes and the lesions of the autointoxications under consideration are probably not due to infection. Splenic swelling as a rule is absent and as pointed out in the foregoing, the genital organs may be free from all signs of infection. Purely mechanical pressure by the uterus cannot explain the conditions; the occurrence of hyperemesis in the early months speaks directly against any such supposition. That they are due to uræmia in nephritis hardly seems possible because in so many cases, probably in the majority, the kidneys show no nephritis but only degeneration, pure and simple, but sometimes so pronounced that the nephrosis dominated the picture. The old theory of Traube-Resenstein to the effect that the cause of eclampsia is cerebral œdema and anæmia certainly does not fit the other forms of pregnancy intoxications, and it is to be noted that it does not explain the characteristic lesions in eclampsia, and finally we have the fact that as a rule there is no cerebral anæmia and œdema in eclampsia. The idea that certain forms of disturbances in pregnancy and hyperemesis are due to reflex irritation or purely hysterical in nature has been expressed, but the severe degeneration of the liver and kidneys, including the infarcts, cannot be explained as due to reflex neurosis or to inanition from excessive vomiting. It is well known that definite changes are found in the organs of internal secretion in pregnancy; the thyroid gland undergoes hypertrophy and appears to secrete more actively than usual; the parathyroid glands present proliferation of the chromophile cells; the chief cells of the hypophysis also increase, and this is true of the cells in the adrenal cortex too; and then there is hypertrophy of the mammary gland and the growth of corpora lutea in the earlier months. Are these changes primary and the cause of the intoxication or are they rather the result of a general

intoxication to which all organs are subject in pregnancy and which perhaps arises in the placenta and the fetus? So far as the mammary hypertrophy and the growth of the corpora lutea are concerned, there can be no doubt of their dependence on the fetus and the placenta, and it seems to me that the best hypothesis for explaining all these different disturbances in pregnancy would be that they are due to pregnancy intoxications. It has been suggested that disturbances in the metabolism of the mother may result in acidosis, but in this case the fundamental cause may still be some form of intoxication. The fact that eclampsia may develop in cases of hydatid mole in which the fetus has been completely absorbed, and the fact that in eclampsia the fetus may show similar changes as the mother suggest that the fetus itself hardly is the source of the intoxication. May not the placenta itself be the source? The epithelial layer of the chorionic villi, usually believed to be of fetal origin, is a secretory organ that independently acts on the material that passes through and it is not unlikely that the supposed toxic substances may arise here. The main results of these brief considerations is that the symptoms and lesions of eclampsia and other disturbances that have been considered are best explained as due to autointoxications, which may originate in the placenta, but the exact nature and mode of action of which we do not now understand. While it is not known that all the disturbances in question are of the same nature, the clinical phenomona differing greatly, still the anatomical changes are more or less similar and present so many connecting transitional forms as to indicate a more or less common etiology.

UNILATERAL INTESTINAL EXCLUSION

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INTESTINAL exclusion in its different forms and varieties is an operation frequently indicated in abdominal surgery. This operation was performed the first time by Trendelenburg, in 1885. Some years later, in 1888, von Hacker recommended it in cases of adhesions and fistula of the intestine, and, in 1891, Salzer published a paper reporting some cases of inflammatory tumors of the cæcum in which he had used it instead of resection. Hartmann made a very complete study of its different varieties, and von Haberer under the direction of von Eiselsberg and basing his opinion on a great number of experiments on animals and on clinical experiences, gave the rules for its use and described the technique as followed by most surgeons.

According to these reports, the operation more often used is the entero-anastomosis of Maisonneuve and its modifications, all of which procedures produce only partial exclusion of the diseased bowel, or bilateral exclusion, with one or both ends of the excluded bowel in communication with the skin.

Unilateral exclusion, that is the procedure by which the gut is completely divided and the proximal end implanted into the side of the distal end, is very seldom used; in fact, most of the surgical textbooks, especially the American and English, for various reasons, do not recommend this method.

Warbasse[1] says: "In unilateral and bilateral exclusion, the excluded ends should be brought out as intestinal fistulæ for drainage. Exceptions may be made to this, but it is the safest practice. The only part of the intestine where regurgitation is not apt to take place is at the ileocæcal valve."

Moynihan[2] says: "The conclusions to be drawn from the evidence furnished both by experimental work and by experience of cases in man is that unilateral exclusion of the small intestine offers no advantages over entero-anastomosis, and in the large intestine does not prevent, at any rate for more than a short period of time, the backward flow of fæcal matter. Unilateral exclusion, save cases of disease affecting the lower end of the ileum, offers no advantages over lateral anastomosis."

"Unilateral exclusion[3] is open to an insuperable objection, rendering it a method unfit for recommendation. It will easily be seen that, in order to make the end of the proximal part of the bowel approach the point of implantation, a gap will exist below the mesentery of the implanted part, through which it will be easy for coils of intestine to pass, making obstruction an easy accident. It is far better, therefore, to make a side-to-side anastomosis instead of an end-to-side apposition."

As we see, there are two serious objections to unilateral exclusion. One is that it exposes the gut to internal strangulation; the other is that it does not exclude because there is always regurgitation and that, therefore, it has no advantage over simple entero-anastomosis. I cannot understand the first objection. In every entero-anastomosis, a gap is formed through which coils of intestine may pass, and consequently produce internal obstruction, if the gap is not closed carefully by suture. There is no difference in the results in this connection between unilateral and bilateral exclusion and very little difference between unilateral exclusion and simple entero-anastomosis. The importance of the second objection depends upon the indications for operation. If exclusion is done to close an intestinal fistula, and there is a backward flow of fæcal matter, of course the fistula will not close, but in this particular also there is no difference between the results obtained with simple entero-anastomosis and unilateral exclusion. Bilateral exclusion would be worse still, because then the surgeon would be

[1] Surgical Treatment, ii, p. 677.
[2] Abdominal Operation, ii pp. 206 and 20.
[3] Keen's Surgery, iv, p. 725.

obliged to avoid closing of the fistula, or else his patient would be exposed to fatal consequences. It is true that in animals total exclusion of a part of the bowel has been done in some cases with good results; it seems that in the normal intestine secretion and absorption hold the balance, so that there are no bad results. But in pathological cases conditions are different, and Wiesinger has published a case where a coil of intestine which was totally excluded for a period of 17 years suddenly caused a mortal peritonitis by perforation. If the operation is done for a total or partial occlusion of the bowel (cancer, tuberculosis, or inflammatory tumor), of course, bilateral exclusion is the only procedure which gives the diseased bowel a complete rest, but it has the disadvantage of leaving an external fistula. Unilateral exclusion, even accepting the backward flow, has a definite advantage over entero-anastomosis, because in the latter some part of the contents is always pushed by peristalsis through the strictured area, while in the former the backward flow does not make a special effort to move the obstacle.

With these considerations as a basis and in spite of the above mentioned opinions of celebrated surgical authorities, I have tried unilateral exclusion in a number of cases, and the results, both primary and definite, have been favorable. I am giving below the details of some of these cases, as I think my results may be of interest and may induce other surgeons to give the method a trial. If their results are satisfactory their opinion regarding the operation, which now seems fixed, may be changed.

Case 1. H. A., male, 20 years of age, entered the hospital January 1, 1915. He had symptoms of partial intestinal obstruction and presented a palpable tumor in the cæcal region. His age, the presence of symptoms of pulmonary tuberculosis, and the insidious evolution of the disease led us to make a diagnosis of ileocæcal tuberculosis. The operation, performed on January 4, confirmed the diagnosis. There was an intense infiltration of the surrounding tissues which made a resection impossible. I decided to do a unilateral exclusion. I cut the ileum some distance from the valve, closed both ends, and implanted the oral end side to side into the transverse colon. Recovery was uneventful and the patient left the hospital one month after the operation (February 4, 1915) greatly improved. He has done well since and is clinically healed. (September, 1922, 7 years after the operation.)

Case 2. M. L., male, age 20, entered the hospital September 22, 1916, was operated upon the next day with a probable diagnosis of subacute appendicitis. The operation revealed an ileocæcal tuberculosis and tuberculosis of the appendix. As the result in the former case had been so satisfactory I did not try a resection, but did an appendectomy and unilateral exclusion with side-to-side implantation of the ileum into the transverse colon. Patient left the hospital 3 weeks after operation and has done well since.

Case 3. Juan A., male, age 32, entered the hospital November 17, 1916, and was operated upon November 23. Tuberculosis of the small intestine with 5 circular tuberculous infiltrations within 1½ meters. After revision of all the bowel, the intestine was sectioned above the highest stricture and implanted side-to-side aboral of the lowest. Recovery was uneventful and patient left the hospital December 5.

Case 4. Herminio M., male, age 21, entered the hospital August 8, 1917. Case very similar to Case 1. Patient was operated upon August 11 and left the 27th. Was doing well 2 years later.

Case 5. Enrique E., male, age 32, entered October 16, 1917; was operated upon the 22d. Tumoral ileocæcal tuberculosis for which unilateral exclusion with implantation side-to-side of ileum in transverse colon was done. December, 1919, he was clinically healed.

Case 6. Mercedes R., hospital nurse, age 23, entered the hospital September 11, 1919. A year ago she had been operated upon in another hospital for peritonitis due to an acute appendicitis. For some time she had a fæcal fistula which closed later spontaneously, but she remained with pains and symptoms of incomplete intestinal obstruction. She was operated upon September 13. The operation revealed extensive adhesions throughout the cæcum and lower ileum; in several points the latter was contracted by narrow bands of adhesions. We decided to do a unilateral exclusion, so we cut the ileum oral to the adhesions and implanted it side-to-side in the transverse colon. Recovery was uneventful; patient left the hospital September 23 and has been well since and can fulfil all her duties as hospital nurse.

Case 7. Clorinda J., female, age 60, entered the hospital April 25, 1920. She showed symptoms of intestinal obstruction which had been going on for some time and had become more intense lately. There was a palpable tumor in the right hypochondrium which the X-rays revealed to be situated in the hepatic flexure of the colon. The operation (April 28, 1920) confirmed the diagnosis. A big tumor, adherent to the liver and to the posterior peritoneum occupied all the hepatic flexure. Macroscopically it looked malignant. As extirpation in sound tissue was impossible, we did a unilateral

exclusion, implanting the ileum in the transverse colon. No complications followed, and the wound healed *per primam*. The patient slowly improved generally, and she left the hospital June 23. Two years after the operation she wrote that she was doing well and had no abdominal symptoms. It was an inflammatory tumor, most likely due to the gall bladder.

Case 8. Margarita G., female, age 46, entered the hospital May 17, 1922. She had been ill for some days with fever and pains in the region of the cæcum. There existed a deep infiltration in the right iliac region (the patient was very stout), and there were symptoms of incomplete intestinal obstruction. Operation was done the next day, May 18, with the diagnosis of appendicitis. On opening the peritoneum, we found a tumor occupying the ascending colon at about 10 centimeters from the cæcum; the cæcum itself looked normal. The tumor was adherent and infiltrating, and there was a number of swollen lymphatic glands in the mesentery. It looked very much like a cancerous growth and I decided to do a two-stage operation, doing in the first stage a unilateral exclusion. The ileum was sectioned and the oral end implanted side-to-side in the transverse colon. The symptoms subsided, the temperature returned to normal and on May 31 (2 weeks after the first operation) I decided to do the resection. But on opening the abdomen I found that most of the tumor had disappeared, and upon careful examination I could demonstrate that all the trouble was due to a very long retrocæcal appendix, with a perforation at its end and a consequent infiltration of the colon and the retrocolic space. I extirpated the appendix, but as patient has been feeling well, I left the ascending colon as it was. Recovery was uneventful; patient left the hospital July 28.

Of these 8 patients I have heard from Cases 2, 4, 5, and 7 and have been able to examine lately 3 (Cases 1, 7, and 8). In none of the patients have there been symptoms which could be attributed to bad results from operation. Of the 3 whom I was able to examine with the X-ray, there was a manifest backward flow in one (Case 7), some in another (Case 6), and nothing in the third (Case 1).

How can we explain this backward flow? Why does it occur in some cases and not in another, and why does it not produce disagreeable symptoms?

Normal peristalsis has been studied by numerous roentgenologists and they have confirmed our observations, that there are always in the ascending colon antiperistaltic waves which bring its contents back to the cæcum several times. In most of the cases the ileocæcal valve is an obstacle which allows the passage of new portions from the ileum, but not back from the cæcum into the small intestine. When the quantity of contents of the ascending colon has reached a certain amount, a peristaltic wave divides it and pushes some of it toward the anus. It is the function of the antiperistaltic waves to bring the contents of the cæcum and ascending colon into close contact with the mucous surface and to facilitate the absorption of the liquids contained.

Roith thinks that the antiperistaltic waves cease from the middle of the transverse colon downward, and that in this location an ileocolostomy with unilateral exclusion would not produce a backward flow. However, these antiperistaltic waves are no doubt the most important, but not the only, cause of the backward flow. In fact a backward flow has been demonstrated even in cases of ileosigmoidostomy, filling up the colon down to the cæcum. And as here no antiperistaltic movement has been noticed, we must suppose the flow is due to mechanical causes alone, although it is difficult to understand them. Stierlin has published a case from DeQuervain's clinic in which backward flow produced so serious symptoms that it was necessary to resect the cæcum and ascending colon. DeQuervain says that he has not seen the phenomenon in cases of tuberculosis for cancer, and explains it by the intolerance of the ulcerated bowel to its contents; there exists a hypermotility which empties the contents very quickly (Stierlin). He thinks that the reflux may appear again when the disease has healed and he has tried stricturing the ascending colon to avoid it. Case 1, in our series, does not confirm this opinion as there is no reflux after 7 years of clinical cure. Case 8 has a slight reflux down the ascending colon, and in Case 7 this reflux goes through the ileocæcal valve into the excluded coil of the ileum. But even in this case there are no clinical symptoms of backward flow, and after some time the intestine empties completely, so that I think we must consider this reflux as a physiological antiperistalsis which has no bad results and contributes, on

the contrary, to better extraction of the intestinal contents.

Basing my opinions on these considerations, I think that we should give unilateral exclusion a fair trial in properly selected abdominal cases. The advantage it has over simple entero-anastomosis is shown by the following case:

Henry B., age 34, entered the hospital February 26, 1918. He had had dysentery for years and suffered lately from intense abdominal pains which made him unfit for any work. The X-ray showed a nearly filiform stricture of about 10 centimeters long in the middle of the descending colon. I operated upon him February 27. The strictured part of the bowel was transformed into a hard cord. I made a simple transversosigmoidostomy with the idea of doing a secondary resection in case it should be necessary. Recovery was uneventful and patient left the hospital March 15. He gained rapidly in weight but the pain did not disappear. We could see with the X-ray that the pains came always when the contents of the transverse colon passed into the descending colon and worked its way through the stricture; the pains did not occur if the contents went through the anastomosis. The curious thing was that the former way of passing was the more frequent, in spite of the intense and painful peristalsis required to push the contents along and in spite of the fact that the anastomosis was of good size. The patient suffered a great deal, but as his general condition was much better and as he knew the dangers of a radical operation, he decided to put off operation until September 10, 1919. At that time I resected the whole descending colon. The operation was difficult because of the inflammatory condition of the bowel. Microscopical examination showed beginning malignancy in the center of the chronic inflammatory tissue, but the patient is now (2 years after operation) in good health and feeling fine.

This case proves that simple entero-anastomosis does not eliminte the strain of intense peristalsis against the strictured part of the bowel. If my first operation had been unilateral exclusion I would have saved the patient a great deal of suffering and would have had much less difficulty in the second operation, because the inflammatory symptoms would doubtless have subsided.

In comparing the advantages of bilateral and unilateral exclusion, there is a distinct advantage in favor of the unilateral method. The patient does not have to suffer the great inconvenience of an external fistula, which produces always a relative invalidity, and often is unable to do any kind of work. Compare this with my patient, Case 1, who has been able to continue his strenuous work as waiter in a hotel during the years since his operations; the same holds true also for Cases 2, 4, 5, and 7.

CONCLUSIONS

From my study of the subject I have drawn the following conclusions:

1. Unilateral exclusion of the intestine offers as great advantages as simple entero-anastomosis and as bilateral exclusion.

2. It is indicated chiefly—

a. In ileocæcal tuberculosis if the extension of the disease or general condition of the patient makes resection impossible.

b. In cancer of the colon if the extension of the disease or the general condition of the patient makes resection impossible.

c. In tumors the diagnosis of which is doubtful (inflammatory or malignant) and which produce stricture of the bowel.

3. Unilateral exclusion is superior to simple anastomosis in that it eliminates any strain on the strictured area and to bilateral exclusion in that it avoids an external fistula.

TUBERCULOSIS OF THE GENITALIA

With Review of Literature[1]

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TUBERCULOSIS OF THE VULVA

MODERN literature is very deficient with regard to cases of tuberculosis of the vulva. White (1) states that 25 per cent occurs in children and that when present in the adult, the age of incidence is between 30 and 40. It is unnecessary to dwell on the types found: two cases have occurred in our practice and both conformed to the hypertrophic variety. Tuberculosis of the type of pseudo elephantiases has not been encountered but it is easy to visualize this as an ending to a conglomeration of tuberculous warts. Bartholin's gland is seldom affected: Lecene (2) has published two cases. The symptoms and signs depend on the variety. Usually the patient complains of a swelling in the part with discharge when ulceration is present. Occasionally, as in a case of ours (a woman aged 36), the swelling assumes a type of pseudo-œdema, i.e., the appearance is that of œdema but there is no pitting on pressure and there are no causes for the apparent œdema. Dr. Pollock supplied the following reports on the above case:

(1) The tissue is mainly dense, fibrous tissue. There are numerous spaces under the epithelium filled with a serous fluid and a similar fluid lies in vascular spaces deeper down. There are collections of small, round cells, some close to the epithelium, some deeper down. The horny layer of the epithelium is distinct and in some places separated from the underlying layers. The down-growths of epithelium forming the papillæ are hypertrophied. (2) The condition appears to be a simple papilloma. Tubercles are present. Most of the enlarged mass is hard, fibrous tissue with small, round-cell proliferation in patches but the condition is undoubtedly tuberculosis.

The treatment of localized growths by excision of the vulva is eminently satisfactory. It is impossible in some to do other than palliative painting with strong antiseptics. X-rays have been used with good effect.

TUBERCULOSIS OF THE VAGINA

For the same reason that the vagina is resistent to inflammation because of its squamous epithelium and absence of glands, so it is rarely attacked by tuberculosis. It is seldom seen as a primary lesion and usually spreads from an infected perineal tear or from a fistula. The diagnosis of this rarity is from such other rarities as cancer and syphilis, and this can often be accomplished only by the microscope. When the growth is localized it must be removed, but as this is impossible in most instances, X-rays, radium, and antiseptic douches may be used to relieve if they do not cure.

TUBERCULOSIS OF THE UTERUS

In considering tuberculosis of the uterus, one must dwell on an ethical side, namely the mode of infection, and in a search of modern literature one meets with varied opinions. It is not intended to delve deeply into the question of infection of male by female but it is just as likely that advice may be sought by couples about to marry as to the likelihood of infection of the female by a potentially tuberculous male as that advice may be sought by a male who may be potentially gonorrhœal.

Bauereisen (3) writing on this subject quotes the case of a widow of a phthisical man who developed a tuberculous endometritis. The uterus was removed and death followed from sepsis: a postmortem examination showed no other lesion. This case seems to be not only one of cohabitation tuberculosis but also one of primary genital tuberculosis—an extreme rarity. Infection must arise either by transmission of bacilli from some other focus or by the direct deposit of bacilli in the vagina. Following experiments in which emulsions of virulent bovine bacilli were injected into the seminal vesicles of four male guinea pigs, the conclusion was reached that

[1] Presidential Address to Obstetrical and Gynæcological Section, Royal Academy of Medicine in Ireland.

spontaneous ascent of the organisms in a normal vagina is impossible but that virulent bacilli may produce tuberculosis of the vagina from which further spread may take place. It is also suggested that movements of the uterus in orgasm and that the spermatozoa themselves may spread the bacilli.

Bauereisen disagrees with Max Muller (4) who states that primary tuberculosis of the genitals is never seen—Muller states that tuberculosis is a descending infection from the tube but this statement is obviously open to criticism in view of cases of vulvar tuberculosis which have been reported with absence of intra-abdominal trouble.

Geipel in an important research on sucklings proved that the tubercle bacillus passes via the respiratory and digestive tracts to the neck, thence by the bronchial, mediastinal, or mesenteric glands to the blood stream and sets up tuberculosis of distant organs. Muller as stated already is very definitely against primary infection and states dogmatically that proof of a local lesion constitutes a proof that this lesion is secondary, for the entry point of the tubercle bacilli usually escapes unscathed; although many will disagree he is of opinion that if the vagina be infected the next site is the regional lymph nodes, then the entire body with retrograde infection of an eroded or lacerated cervix as a point of lowered resistance. Max Kroner (5) says that either uterus or tube is infected independently by the blood or lymph or the endometrium is infected by spread from the tubes. In the latter cases the infection may travel from tube to blood stream and then to the uterus, or the endometrium is affected by tuberculous secretion from the tubes. Immunity is a powerful factor in genital tuberculosis, for it has been proved that when sperm containing tubercle bacilli are inoculated into the vagina, safety depends on the immunity acquired in childhood; when immunity is absent the disease is fulminating and progressive. Many writers have reported cohabitation tuberculosis.

TUBERCULOSIS OF THE CERVIX

Tuberculosis of the cervix is extremely rare and when present is difficult to diagnose both clinically and microscopically from malignant disease. The classification of ulcerative and proliferating, which is usually given, helps in no way to distinguish them and the symptoms are akin. In a case reported by Rudeloff (6), when a piece of cervix was removed and found to be malignant, on further examination after Wertheim's hysterectomy had been performed, tuberculosis of the cervix was diagnosed. The chief fallacy lies in confusing cell nests with epithelioid cells, and while general opinion is unanimous in agreeing that skilled pathologists may find it impossible to make a diagnosis, this can be done if the greatest care is taken in making a differential diagnosis between cell nests and epithelioid cells. The glassy appearance of the protoplasm is another important diagnostic point. Authorities agree also that cases of tuberculous disease of the tubes are often associated with a simple erosion which may contain apparent cell nests from which an incorrect diagnosis of carcinoma may be made.

Enough has been said to justify the warning to the microscopist to cut many sections in case of the slightest doubt in differential diagnosis between erosion, tuberculosis, and cancer. The treatment resolves itself into high amputation of the cervix, X-rays and Wertheim's hysterectomy. If the disease is localized, high amputation should be done with curettage of the corpus uteri. If bimanual examination reveals any intra-abdominal trouble, Wertheim's hysterectomy is the choice. If there is extragenital involvement, the local condition should be treated by caustics or X-rays.

TUBERCULOSIS OF THE BODY OF THE UTERUS

Corporeal tuberculosis in the form of endometritis is indistinguishable clinically from other forms of endometritis and the microscopic appearance may not help in the diagnosis.

Kundrat (8) states that despite this difficulty, if the whole picture be taken, a diagnosis may be made. In his series of 61 cases, the bacillus was found only 30 times, an experience encountered in our practice. Sometimes the cornua are attacked as part of a tubal infection.

Occasionally as in a case reported by us (7) the uterus assumes the appearance of a fibroid uterus and is often mistaken for it. The treatment of tuberculous disease of the body resolves itself into that for cases in which (1) endometritis only is present, when curetting usually cures; (2) the myometrium is involved and the body is enlarged, when treatment depends on the amount of tubal involvement and other factors which will be dealt with when considering this part of the subject.

TUBERCULOSIS OF THE TUBES

Tuberculosis of the tubes is the most common type of tuberculosis of the genitalia and may be looked upon as one of the common ailments of women, and therefore one which deserves more attention on certain points which will be shortly referred to. Its frequent occurrence is probably due to the many folds of the tube and the small circumference of the uterine ostium. The probable modes of infection have already been dealt with. With regard to frequency of tuberculosis in a series of 390 salpingectomies total or partial which we performed for tubal disease, there were 54 cases, or nearly 14 per cent. The varieties met with are differently described in various textbooks. Generally speaking they may be divided into cases in which (1) the tubes are slightly enlarged and when the abdomen is opened the definite diagnosis of tuberculosis is impossible; (2) the tubes are much enlarged and no tubercles are present; (3) the tubes in which tubercles are present and the diagnosis is obvious; (4) the tubes and abdomen are involved in generalized tuberculosis. The importance of this classification will be made evident when dealing with treatment. The symptoms of tuberculous salpingitis give no clue to the disease. Sometimes there is a family history of tuberculosis. Sterility and leucorrhœa are the most common complaints we have met with. Menstruation lasting for 2 days, ceasing for a day and then continuing for 2 or 3 more days leads one to suspect tubal disease when nothing can be felt macroscopically. Pestalloza (9) and others find amenorrhœa as a symptom but we have found that this is present only in cases of large pyosalpinx involving the ovary or where the patient is generally phthisical. Dysmenorrhœa, menorrhagia, and metrorrhagia are occasionally seen.

Pains in the side and back are present when a tuberculous prosalpinx assumes much size or when abscess forms, and rise of temperature and pulse are found when the condition is acute or in the presence of exacerbation of a chronic case. As has been stated already the diagnosis by symptoms is very often impossible and even when the abdomen is opened and later at the microscope, tuberculous salpingitis may still be a matter for question. The signs depend on the variety and there may be felt varying degrees of enlargement from a slight thickening of the tube to enormous pus sacs. Sometimes the diagnosis presents the greatest difficulties. A case lately came under our observation which I will report.

A woman, age 64, gave a history of no note except that she had remarked a tumor in the left side of the abdomen for some months. On bimanual examination the uterus was palpable in front with a tumor adherent to the left broad ligament. This tumor was apparently the size of two clinched fists, and a diagnosis of malignant degeneration of a myoma or cancer of the colon was made. An X-ray diagnosis made by Dr. Hardmann after a barium meal was as follows:

"Obstruction in transverse colon but one cannot say whether due to a primary growth of the bowel or due to adhesions between the colon and the palpable tumor which may be colonic." As the definite diagnosis had not been made by clinical methods and X-rays it was decided to give a barium meal by the rectum, after which the report read: "The opaque enema flowed back as far as the hepatic flexure, when it ceased to advance, confirming the former diagnosis of obstruction in that region." At laparotomy difficulty was experienced in opening the abdomen because of adhesions. After many of these were broken down a condition of double pus tubes was demonstrable. These were enucleated and all bleeding points stopped and a cigarette drain inserted in the pelvis because of oozing. The tumor on the left was distended intestine adherent to the pus tube. The adhesions on all sides confirmed the X ray findings.

This case is reported to show the extreme difficulties which may exist with regard to diagnosis. We have dealt with and sent a questionnaire to only 54 of our cases, as we considered that number would be sufficient for our present purpose, but the number of cases of sterility which we have encountered

in which the patients had been curetted many times for cure (?) of sterility and leucorrhœa and in which tuberculosis was present makes us reiterate our counsel that the abdomen should be opened in all doubtful cases of sterility and we say this despite recent work by Rubin (10) Rongy (11) and others on insufflation of the tubes with carbon dioxide. We have one case in our series where the unfortunate woman had been curetted four times by three different men when she was suffering from two large tuberculous pus tubes. Such cases as these should be easy to diagnose. The main purpose in the questionnaire was to ascertain if possible the correct treatment for tuberculous salpingitis, and we believe that we have found the correct treatment. Every patient for whom we did double salpingectomy was in perfect health in every way since the operation. Every patient in the series who had a partial salpingectomy with a view to cure of sterility, had various after-complaints and two contracted abdominal tuberculosis while none became pregnant. In any case where hysterectomy was done in addition the patient had good health, but this operation is unnecessary except where the uterus is involved in tuberculous pyometra, but it is often necessary to remove portions of the cornua at the uterine insertions of the tubes. To bear out the futility of performing hysterectomy in addition to salpingectomy we have examined curettings which have been found to be tuberculous before operation. Three months after salpingectomy curettings examined again were found to be free from disease. In other words our early hopes of palliative measures on the tubes for tuberculous salpingitis have not been borne out by the subsequent history. There is no doubt that isolated cures of sterility are accomplished by resecting tuberculous tubes, but these are so isolated and the results are so much better from complete salpingectomy that the latter is the operation of choice. We do not mean to convey that plastic work should not be done for other forms of tubal disease. This is a very different matter and the good results obtained thereby justify the operation. In other words the ideal treatment of tuberculous disease of the tubes is to remove them—not to resect them. In cases where it is impossible to diagnose take the risk and resect them. If later the microscope reveals tuberculosis and the patient suffers, a second operation may be done. When the abdomen on being opened is found to be involved generally in disease, the mere opening and closing is found to have good results, in some cases; in others, they go down hill rapidly. In some cases, however, where the disease appears to be generalized in the abdomen, it is possible to enucleate pus sacs which are present on both sides. If this can be effected, the prognosis is more favorable. Stevenson (12) has reported good results with radium, and Crofton (13) with vaccines. Vogt (14), in a communication on the combination of operative and X-ray therapy, finds that the radical operation gives the best results when possible but that prophylactic radiation, i.e., radiation after operation (either when it has been possible to remove disease or not) improves the after-results, i.e., operation followed by X-rays is the best treatment. When operation is contra-indicated for any reason X-rays alone should be used. We have found that operation without X-rays in most cases is sufficient but some patients are benefited by a course of postoperative X-rays. In the same way postoperative vaccine treatment is a great help to many, but we deprecate strongly the treatment of tuberculous salpingitis by vaccines, where the abdomen has not been opened to make the diagnosis definite.

We have not dealt with tuberculosis of the ovaries. As a separate entity it is rare: when present it is nearly always bound up with the diseased tube and should be removed with it.

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MALIGNANT NEOPLASIA OF THE KIDNEY OCCURRING IN INFANCY

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MALIGNANT tumors of the kidney, occurring in infancy, have been widely studied both by means of individual and collected cases. Various views have been advanced with regard to the microscopic interpretation and the pathogenesis. The hypothetic doctrines of cell rests and embryonic inclusions and the theory of metaplasia have been drawn on for explanations. Confusion, rather than clarity, has been the result. In early studies of the condition, tumors were designated by the broad term, "cancer." Eberth, finding muscle fibers in a "fibrosarcomatous" growth, commented on the mixed character of the tumor. Jacobi believed that most of the renal growths occurring in children were sarcomatous. Birch-Hirschfeld drew attention to the epithelial tubules embedded in sarcomatous tissue. Such neoplasms have been designated in the literature, as embryonic carcinomata, adenosarcomata, adenomyosarcomata, adenochondrosarcomata, myosarcomata, teratomata, and adenocarcinomata. A diffuse cellular growth with epithelial tubules, fibrous tissue, striated and unstriated muscle, cartilage and bone are said to occur in these tumors.

Such tumors are now usually designated as the mixed embryonic tumors of Wilm; they are also referred to as adenosarcomata (Ziegler), composite tumors (MacCallum), and adenomyosarcomata (Ewing). Ewing also recognizes an embryonal adenocarcinoma, occurring in children. Garceau asserts that these tumors show certain structures which have been called carcinomatous, but the presence of sarcomatous elements, as well as the character of the tumor precludes the possibility of classifying them with carcinomata.

Bland-Sutton says: "The renal sarcomata of infancy arise in the connective tissue of the renal sinus. The epithelial cylinders are due to the entanglement of uriniferous tubules, in consequence of the sarcoma invading the cortex, while the striated spindles are derived from the muscle tissue of the renal pelvis. . . . These studies demonstrate in no uncertain way that renal sarcomata in infants are extrinsic in origin and strictly non-renal."

Three views with regard to pathogenesis have been maintained: that the tumors are derived, (1) from the Wolffian body, (2) from the embryonic kidney, or (3) from aberrant cells of the myotome or other similar structures (Wilms). The latter theory has been accepted as the most probable.

The material of this study consists of seven renal neoplasms from seven children (six females and one male); the eldest was 7 years, and the youngest 20 months of age. The growth was situated on the right side in five cases, and on the left in two. The largest tumor weighed 760 grams.

REPORT OF CASES

Case 1. (A360819.) E. F. M., a girl, age 4 years, was operated on for removal of the right kidney; a neoplasm measuring 13 by 10 by 18 centimeters, and weighing 525 grams was revealed. The mass was nodular and consisted of a distorted kidney in the substance of which was a solid, irregular mass. Upon gross section, hæmorrhagic cystic degenerating areas were found. The color and general appearance of the cortex of the distorted kidney were normal, although it was thinned by dilatation of the calyces and pressure of the neoplasm. The mass was intimately associated, grossly, with the renal tissue; it was definitely invasive (Fig. 1). Low power microscopic examination showed two apparently distinct types of tissue (Fig. 2). These were diffuse (Fig. 3) and glandular (Fig. 4). When examined with the oil immersion lens, the cells comprising these two types were morphologically identical, the only difference being the degree of differentiation of those of the glandular type. Efforts to determine whether or not these cells have a common origin have been futile; the two types are often fused. The presence of these apparently different types of tissue (with the low power of the microscope) has been responsible, doubtless, for the term, "mixed tumors."

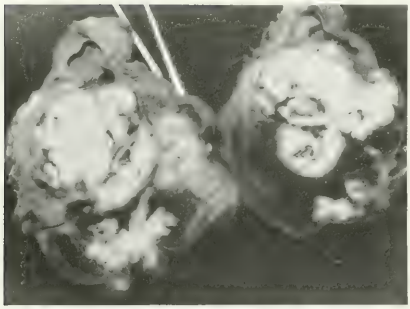

Fig. 1. Gross specimen from Case 1.

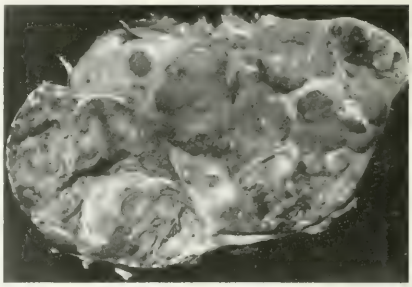

Fig. 2. Gross specimen from Case 2.

Case 2. (A358573) D. G., a girl, age 7 years, was operated on at the Clinic; the right kidney, removed at operation, weighed 760 grams. The mass was nodular and consisted of a distorted kidney in the substance of which was a solid degenerating hæmorrhagic neoplasm. This neoplasm, by pressure and invasion, had almost completely destroyed the renal cortex and obliterated the renal pelvis. The distorted renal cortex was infiltrated and almost completely replaced by scar tissue (Fig. 5). This neoplasm also was apparently composed of two types of tissue, one, diffuse (Fig. 6), and the other, glandular (Fig. 7). The tissues were fused; the cells themselves were morphologically indistinguishable under the oil immersion lens. The differentiation into glands is higher than in (Case 1).

Case 3. (A73668.) S. C., a girl, age 5 years, was operated on at the Clinic. Right nephrectomy revealed a spheroid, somewhat nodular mass consisting of a distorted kidney and a solid infiltrating neoplasm. The renal cortex, pelvis, and calyces were practically obliterated, although small traces of the cortex identified the neoplasm as a renal tumor (Fig. 8). The neoplasm, as in (Cases 1 and 2) was composed essentially of two types of tissue, one, diffuse (Fig. 9), and the other, somewhat glandular (Fig. 10). The cells under the oil lens were indistinguishable, the only apparent difference being a low degree of differentiation into glandular arrangement.

Case 4. (A244983.) S. K., a boy, age 4 years, was operated on at the Clinic; an enlarged left kidney, weighing 440 grams, was removed, and was found on gross section to contain a hæmorrhagic, degenerating, solid, infiltrating neoplasm which had partially distorted the renal cortex and almost completely obliterated the renal pelvis and calyces (Fig. 11). This neoplasm presented two types of tissue on low power examination, one, diffuse (Fig. 12), and the other, glandular (Fig. 12 and 13). On examination with the oil immersion lens the cells were found to be indistinguishable, morphologically, the only difference being the partial differentiation into glandular structure (Fig. 13).

Case 5. (A283231.) L. L., a girl, age 20 months, was operated on at the Clinic; the right kidney, weighing 670 grams, was removed. Photographs were not made of the gross specimens, but micros-

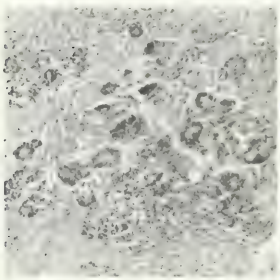

Fig. [illegible] Photomicrograph of specimen from Case [illegible]. (×500.)

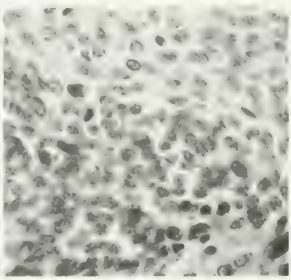

Fig. [illegible] Photomicrograph of specimen from Case [illegible]. (×500.)

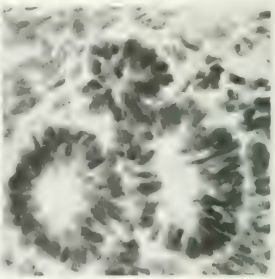

Fig. 4. Photomicrograph of specimen from Case 1. (×500.)

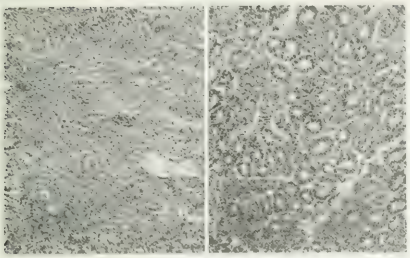

Fig. 6 (at left). Photomicrograph of specimen from Case 2. (×70.)
Fig. 7. Photomicrograph of specimen from Case 2. (×70.

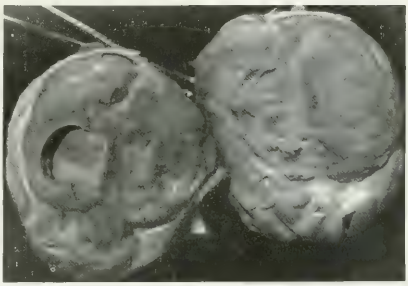

Fig. 8. Gross specimen from Case 3.

copic sections revealed a diffuse (Fig. 14) and glandular (Fig. 15) growth. In this specimen, as in the others, the cells were occasionally partially differentiated in gland-like structures.

CASE 6. (A253437.) E. McK., a girl, age 3 years, was operated on at the Clinic. Removal of the right kidney revealed a mass 11 by 7 by 4 centimeters which, on gross section, was found to consist of a small portion of the renal cortex and ovoidal hæmorrhagic, degenerating, solid neoplasm which apparently had distorted, partially destroyed, and infiltrated the kidney. The calyces and pelvis were obliterated (Fig. 16). Microscopic examination revealed diffuse and glandular neoplastic tissues which were fused in portions of the sections (Fig. 17). Like the cells in Case 2 (A358573) the glandular differentiation was of a rather high degree and on low power study the glands appeared to be composed of columnar cells. Under oil immersion the cells themselves were not columnar; they were still undifferentiated and resembled those of the diffuse portions of the neoplasm.

CASE 7. (A123624.) E. T., a girl, age 4 years, was operated on at the Clinic. A solid nodular mass removed from the left side was composed of a distorted kidney and a solid, hæmorrhagic, infiltrating neoplasm. The renal cortex, although almost completely destroyed, was easily recognized in spite of the extrinsic replacement by scar tissue. The renal calyces and pelves were obliterated (Fig. 18). On microscopic section this neoplasm, like the others, was found to be composed of diffuse neoplastic tissue (Fig. 19) and glandular tissue (Figs. 20 and 21). The cells of both apparent types of tissue were indistinguishable under oil immersion lens (Fig. 21).

In the microscopic examination of these specimens it was found that they were composed of one type of cell in various stages of differentiation and with varying amounts of connective-tissue reaction. The appearance

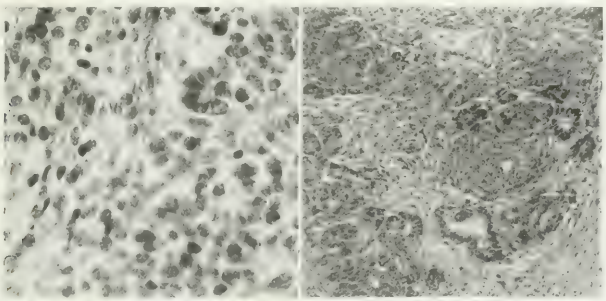

Fig. 9 (at left). Photomicrograph of specimen from Case 3. (×500.)
Fig. 10. Photomicrograph of specimen from Case 3. (×100.)

Fig. 11. Gross specimen from Case 4.

of the cells under the oil immersion lens and their tendency to form into gland-like structures leads us to classify the neoplasm as carcinoma of the adenomatous type. There does not appear to be any resemblance between these glandular structures and the normal renal tubules.

Since the low power pictures of these specimens vary, and the cytological studies reveal that the variation is the result of degrees of differentiation, it would seem that a classification based on cytological differentiation might be utilized instead of a classification largely based on low power resemblance to normal tissues. Neoplastic cells which bear no cytological resemblance to any adult tissues are often arranged in glandular form and still are not adult cells. The malignancy depends, in large part, on the degree of differentiation. Thus a neoplasm wholly composed of gland-like structures, formed by neoplastic cells, is in all probability less malignant than one composed of the same type of cells diffusely arranged.

It might be suspected that there are varying degrees of malignancy, since there is great variation in degree of differentiation in the neoplasms. They have both undifferentiated and partially differentiated tissues of the same apparent type of cell and wherever undifferentiated neoplastic cells exist a bad prognosis may be expected.

Three of the seven children died within a year after operation; two are alive, but not well, 1 year after operation. One is perfectly well 18 months after operation, and one cannot be traced.

Since these neoplasms are composed of cells which resemble adult tissues in arrangement, but morphologically are unlike any normal adult tissue cells, we prefer to classify them as pseudotextomata.

Group 1. Textoblastomata or blastomata embrace all neoplasms which are composed

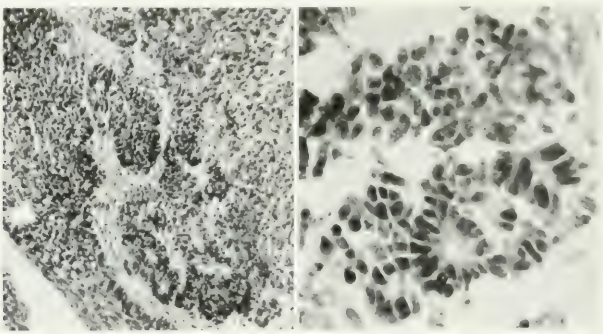

Fig. 12 (at left). Photomicrograph of specimen from Case 4.
Fig. 13. Photomicrograph of specimen from Case 4.

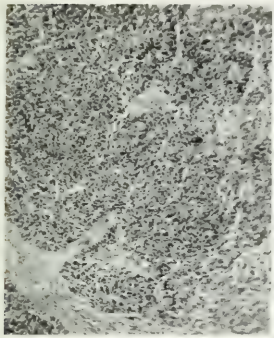

Fig. 14. Photomicrograph of specimen from Case 5. (×70.)

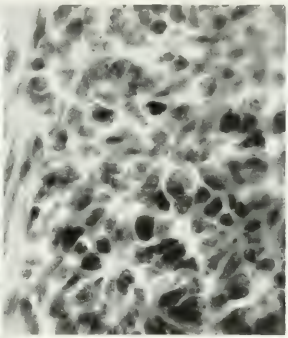

Fig. 15. Photomicrograph of specimen from Case 5. (×500.)

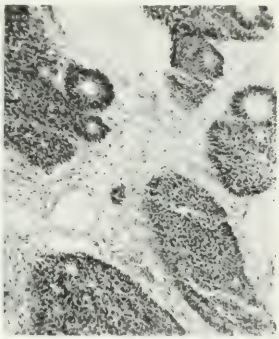

Fig. 17. Photomicrograph of specimen from Case 6. (×70.)

of cells so undifferentiated that it is impossible positively to recognize the textocytes into which they would develop if differentiation occurred. They are neoplasms, the principal cells of which do not resemble any adult textocytes in the organism. Such neoplasms occur in practically all parts of the human body; they are usually, if not always, soft, vascular, cellular tumors possessing the power of rapid growth, invasion of neighboring tissues, and of metastasis. They have been called sarcomata, but all the neoplasms in the literature which have been called sarcomata do not belong to this group, since many consist of cells which are partially differentiated and hence belong to Group 2, the pseudotextomata.

Group 2. Pseudotextomata embrace all neoplasms which are composed of partially differentiated cells and hence resemble, in arrangement, certain normal adult tissue cells of the organism. Such cells, however, do not have the exact morphology of adult textocytes, although they may be arranged similarly to the normal arrangement of adult tissue. Thus the partially differentiated cells may be arranged in planes, like the cells lining the alimentary tract, blood vessels, ducts or the epidermis of the skin; they may line a sphere or a portion of a sphere such as the acini of the glands. The cells may be arranged with or without having their long axes parallel or forming the radii of a sphere.

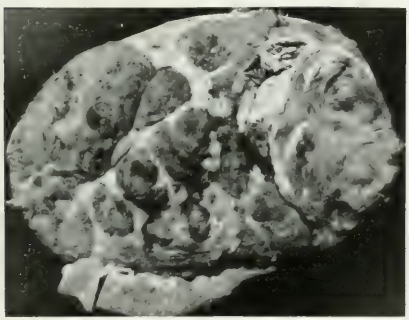

Fig. 16. Gross specimen from Case 6.

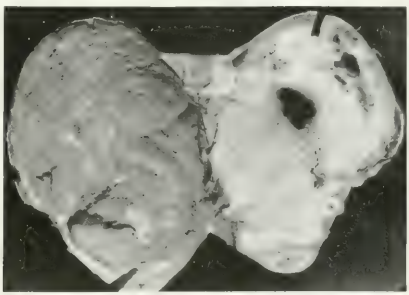

Fig. 18. Gross specimen from Case 7.

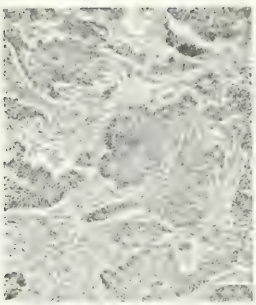

Fig. 19. Photomicrograph of specimen from Case 7. (×70.)

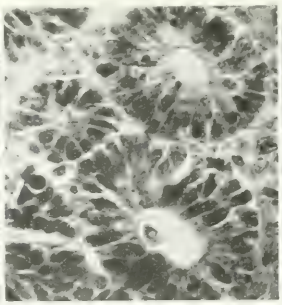

Fig. 20. Photomicrograph of specimen from Case 7. (×500.)

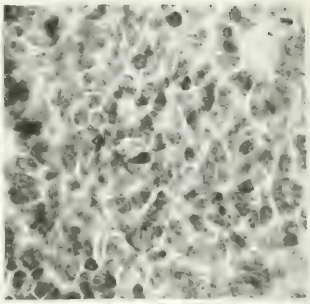

Fig. 21. Photomicrograph of specimen from Case 7. (×500.)

Group 3. Textomata embrace all neoplasms which are composed of cells sufficiently differentiated to be morphologically identical with, or indistinguishable from, normal adult tissue cells (textocytes). In the production of such neoplasms the differentiation is apparently complete; but the rate of differentiation remains parallel to the increased rate of hyperplasia, hence the neoplasm continues to grow; but as the result of the close proximity of the two rates, the growth is slower than that of pseudotextomata and textoblastomata, in which the rate of differentiation is slow, or there is no differentiation.

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LONGITUDINAL OVERGROWTH OF LONG BONES[1]

By KELLOGG SPEED, M.D., F.A.C.S., Chicago

LIVING long bones grow in two general directions. They must increase in the transverse diameter to respond to the call of weight bearing and the augmenting activities of life; they must increase in length to bring the individual to his mature stature. With the first mentioned growth we are not interested at this time; it is a regular, steady thickening of the bone shafts and ends, compensatory in character, and so uniform is the process that little attention is paid to it. If we agree with Macewen, we may believe that the periosteum limits this growth while holding the bone in the shape desired for its particular purpose, and also preventing bone cells from wandering out into adjacent tissue to cause disturbances which would interfere with normal physiological action.

Disturbances of growth of long bones in their longitudinal axes are fairly common, and as they lead to skeletal changes involving the whole body and result in disability and disfigurements, they assume surgical importance. A year ago I reported a series of instances of longitudinal growth interference following osteomyelitis among adolescents,[2] principally in the nature of stoppage of growth. Some of the experimental and physiological findings in that connection were reviewed and operative remedy for these deformities was suggested. When one bone in the forearm or leg ceased growth following inflammation of its epiphysis or diaphysis, embarrassing deformities with deflections of hand or foot resulted.

At this time we are interested in the opposite side of the problem, namely where the lesion influencing the normal growth is of such a character that instead of being destructive and damaging to the epiphyseal cartilage plate so that growth ceases, a stimulation seems to take place resulting in too much growth. This excess growth as directed toward the long axis of the bone is shown by an overgrowth or visible lengthening of the limb involved. This lengthening may take place without simultaneous increase in the transverse diameter of the bone, without increase in the size of the limb except its length and, as a rule, tends to lengthen only that portion of the limb involved in the process, leaving the remainder and the body as a whole uninfluenced as to normal size.

We understand that certain common factors frequently influence the growth of adolescent bones. The various diseases of bones, as rickets or osteomalacia, chronic or even acute illness, untoward action of the various glands of internal secretion, and even influence of the nervous system, may affect size and length of long bones. This is usually, however, a symmetrical process. A unilateral enlargement of the whole body may occur, involving the bones of the head, chest, pelvis, arm, and leg. This is really unilateral macrosomia (hemihypertrophia totalis or crossed inequality), unrecognized cases of which have been reported.[3] Black-Milne[4] reported one instance of macrosomia and also one instance of congenital overgrowth of the right leg, examples of which I have seen and which we call localized giant growth. In one child the whole side of the body was larger than the opposite or normal side, the leg being not only heavier and thicker but also longer. The second patient described in Black-Milne's report was unique. The only part of the body involved was the right leg which was ¾ inch longer than the left leg, but its musculature was not so well developed. The spine and pelvis had bent to allow for this overgrowth. The strange point was that the father of this family in which there were four sons including the one described, had the same anomaly in about the same degree. This case does not appear to be localized giant growth, but may fall into the class of those I am about to report. Other references are also of interest.[5]

The instances of long bone overgrowth I wish to record are different. They are closely connected with and subsequent to inflam-

[1] Speed: Surg., Gynec. and Obst., 1922, April.

[2] Journ. A. M. A., Sept. 16, 1922, [illegible].

[3] Brit. J. Child. Dis., 1920, xvii, 79.

[4] Coston. Med. Record, 1920; xcvii, 222; Gordinier. Albany M. Ann., 1918, xxxix, 37.

Read Before the Chicago Surgical Society January 5, 1923. (For discussion see p. 847.)

mation of varying degree, one instance seemingly starting from a trauma without resulting in an inflammation that formed pus. Their like must occur elsewhere although the literature on this topic is scant.

Reed[1] in his work on the growth of trees concludes that the rate of growth of organisms may be considered as a chemical reaction which gives the mature organism as its end product. Moreover, the given organism grows at a definite rate which is, at any moment, proportional to the amount of growth yet to be made. These instances of overgrowth then must occur in adolescents who still have a certain amount of normal growth coming to them, but some stimulation as from the action of toxins of an inflammatory process in or near the growing part of the bone which leads to length overcomes the natural limit and growth goes on beyond any intended normal extent. This is not a delay in ossification nor a prolongation of the cartilaginous life of the epiphysis but is really an overgrowth as far as these cases show, because the growth occurred when the patient was 4 or 5 years of age. It is apparently not comparable to the wild growth infiltration of malignant tumor cells which go on to destroy the whole organism. While the length growth of the bone seems wild and uncontrolled, it is not deadly and must soon reach its limit.

We understand that length growth of long bones takes place in the cartilage plate and the juxta-epiphyseal region of the diaphysis, ossification continuing to extend behind the cartilage plate which goes on growing. The epiphysis of a long bone ossifies first at the end of the bone where the greatest increase in length takes place, namely that end toward which the nutrient artery is directed. Ollier has attempted to prove that exhausted nutrition in the bone indicates which epiphysis will unite first. When the growth has nearly ceased, there the epiphysis unites so that the epiphysis which unites last with the shaft is the one with the most active proliferation. But this difference in the two ends of the shaft of the bone is manifested from the time of birth, before any epiphysis has appeared or joined on. We may then consider that the unequal growth of the two ends of a long bone is caused by the unequal value of the epiphyseal cartilages, being indicated from birth independent of the union of the epiphyses. A bone shaft in an adolescent may be completely resected for osteomyelitis but if it regenerates it may equal or exceed its fellow bone in length. I have had such an experience after shaft resection where the juxta-epiphyseal area was left behind. Davis[2] reported an instance of transplantation of an epiphysis into a defect in the fibula, the newly implanted bone uniting and giving a final satisfactory length by growth. In this instance the implanted growing bone took up the function of its new environment and conformed to the requirements exacted of it.

Poland quotes Bruns as finding in 100 cases of traumatic epiphyseal separation, 13 instances of arrest of growth. The reason we do not find a greater number of growth arrests is probably because traumatic epiphyseal separations are quite uncommon in the first decade of life. Also, in most instances, the plane of separation is probably one which passes through the layer of partly formed bone just next to the cartilage and not through the cartilage itself. Consequently the osteogenetic layer of the bone remains uninjured and its growth function continues normally. If the cartilage is injured and the patient is 15 to 18 years of age, the growth interference is not liable to be so extensive.

Bone lengthening is rarer than bone shortening. After fracture 6 cases of lengthening of the femur have been mentioned by Bruns. This may explain the fact that fractures of the femur in children, which heal with overriding, in later life show no shortening. I have seen at least 20 instances of this compensating growth. Ollier says this lengthening cannot exceed $^1/_{15}$ or $^1/_{20}$ of the total length of the bone, so we must not count too much on it.

An irritation of the required character applied to the medullary cavity of a bone or to the periosteum at a distance from the epiphyseal cartilage may induce overgrowth and hypertrophy with lengthening of the bone. As far as we know, this irritation must be indirect; if the cartilage cells are directly irri-

[1] J. Gen. Physiol., ii, 545.

Fig. 1 (at left). Case 1. The increase in leg length with difference in muscle bulk, especially from knee to foot is seen. The tilting of his pelvis is shown by the marks on the anterosuperior iliac spines.

Fig. 2. Roentgenogram of both legs of Case 1, showing knee joints on same level, with increase of length in tibial shaft. The fusion between tibia and talus is apparent and the fibula seems to have kept up in relative growth with the tibia. Increase in length equals nearly 2.5 inches. The left tibia shows increase also in diameter with some bowing and with suggestion of cavities within the bone.

tated and stimulated we are more likely to find a death of cells and a stoppage of growth. This has been proven experimentally as mentioned in detail in my report a year ago. Ollier reports that a central osteitis of the tibia with a quiet necrosis of bone induced a lengthening of the bone of 6 or 7 centimeters.

If suppurative osteomyelitis or trauma near the juxta-epiphyseal area with or without some separation of bone leads to bone lengthening, we may assume that the cells in the cartilage plate were not directly inflamed or injured but that they were indirectly stimulated and an overgrowth resulted. Had the infection or trauma caused direct interference with these cells, stoppage of growth might be expected. However, in the instances here described, although the bone in some was thickened beyond normal, the amount of long overgrowth did not seem proportionate to the thickening. We found also that the epiphyses appeared quite normal and did not show gross changes nor delay in closing in the mature individual. The growth seems to lie clearly in the diaphysis, the osteoblasts becoming superactive, laying down too much bone. The following clinical cases seem to be examples of this rare type of overgrowth.

Case 1. A. B., male, age 45, a farmer. When 6 years of age a thorn penetrated his left leg just above the ankle. Inflammation and abscess followed, so that 10 days later, when the abscess was lanced, the thorn was evacuated 6 inches above its point of entrance. A sinus discharging pus developed which cast off a few small pieces of bone and persisted for 15 years. From the age of 22 to 38 years the sinus and pus discharge disappeared but from the latter age to

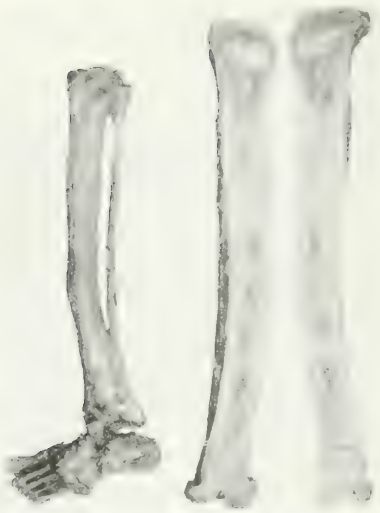

Fig. 3 (at left). Amputated leg bones specimen. The thickening of the tibia, its anterior bowing and fusion with the talus, is shown. The fibula appears to have kept pace in growth with the tibia.

Fig. 4. The tibia sawn open longitudinally. The great thickness of cortical bone laid down during the long course of the osteomyelitis, the fusion with the talus with all loss of ankle joint surface, the cavities of the old medulla and the fresh sequestrum in the head of the bone in the old epiphyseal area, are shown.

the time of admission to the hospital, nearly 7 years, pus had been discharging intermittently. During these years he has been able to continue his work. In his boyhood he formed a habit of standing on his good leg, seldom putting any more weight than he could help on the diseased leg. At one time during the acute condition during confinement to bed he had allowed the leg to lie for a long time on one side, so that it seemed later to bend outward a little. To overcome this a brace was worn to straighten the leg. His ankle became very painful and later quite stiff but there never developed any sinus near the ankle joint. He felt that his ankle and foot used frequently to get out of place in some manner after use, so that he had to sit down and attempt to push his foot back into position. Up to a short time ago, he weighed 200 pounds, but within 3 months he lost rapidly about 30 pounds in all. For the last 3 weeks he has had much pain in his left knee, this with an increase in discharge of pus really bringing him to the surgeon. No operation except the original stab lancing of the leg abscess has ever been performed on the leg. His past history discloses chicken pox, typhoid fever, and mumps in adolescence. For the past 12 years, up to 2 years ago, he has had asthma of an infective bronchial type. After he was married, age 24 years, he had measles. Two brothers are dead, one of pulmonary tuberculosis and anal fistula, the other of a rapidly wasting condition following influenza in 1918, probably pulmonary tuberculosis.

His physical examination reveals little of interest except the essential pathology in the left leg. A cardiovascular examination shows no palpitation or adventitious heart sounds or enlargement. Hands and feet are not swollen but there is slight shortness of breath on exertion. His genito-urinary history is negative. His blood showed 8,250 white blood cells, hæmoglobin 85 per cent; blood pressure 124 systolic, 88 diastolic; Wassermann negative. An X-ray examination of the chest shows the findings of a possible incipient tuberculosis of the left apex, not definite. On the day of hospital admission, November 20, 1922, 4 drops of urine reduced 5 cubic centimeters of Haines' solution, but was otherwise negative.

The main interest lay in his left leg, the right leg being normal in all respects. He walked with considerable lameness and thought that his left leg was shorter than the right. Left knee and hip motion were of normal extent but lately (3 weeks) the knee had become painful. The knee joint was not swollen. The left ankle was firmly ankylosed but there was considerable compensating motion in the mid-tarsal joints.

The left leg presented anterior bowing, especially in its lower half. The lower two-thirds of the tibia were thickened, and there was a small, recently closed fistula in the lower portion near a number of small old scars on the outer surface of the shin. About 8 centimeters from the lower border of the patella on the shin was a tender area, which extended upward toward the tibial tubercle.

Measurements of the lower extremities were as follows:

	Left	Right
Anterosuperior iliac spine to internal malleolus	30 inches	30.75 inches
Superior border of patella to internal malleolus	16.75 inches	17.50 inches

There was present then a lengthening of the whole leg equivalent to about 2.25 inches over the normal right leg. Most of this lengthening, as far as measurements showed, seemed to be in the tibia.

X-ray examination of both tibiæ showed no change in the right tibia, but the left showed great thickening with evident cavity and cloacæ formation in the shaft. The talus was apparently fused on to the lower end of the tibia, but did not interfere with the definite localization of the internal malleolus for measurements.

After a week's preparation on restricted diet, finding that the patient's temperature now remained

Fig. 5.

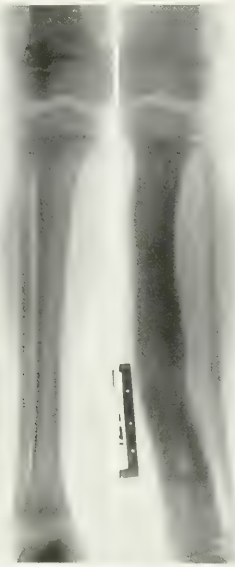

Fig. 6

Fig. 7

Fig. 5. The second patient showing the increase in leg length with pelvic tipping and tibial thickening. The overgrowth lies in the elongated tibia.

Fig. 6. Roentgenogram of both legs of Case 2. The knee joints are on the same level, and the increase of length of the infected leg is seen. The shaft of the infected tibia is typically thickened as in chronic osteomyelitis; cavities are apparent deep in the bone. The upper end of the fibula appears to have lagged behind slightly in growth. The epiphyses of the infected bone appear unchanged and compare favorably with the normal leg.

Fig. 7. Lateral views of the leg of the second patient with confirmation of the findings given in Figure 6.

about 102° each day and the amount of urinary sugar showed no intention of decreasing, a mid-thigh amputation under gas oxygen anæsthesia was performed. There was no shock, and within 4 days after amputation all evidence of sugar in the urine disappeared and never again returned during his hospital stay of 3 weeks. The stump was healed, with stitches removed, by the ninth day.

The amputated leg was dissected; no pus pockets were found in the soft parts. There was no septic thrombophlebitis and the knee joint was negative. The vessels showed a fair degree of sclerosis. The tibia and fibula were cleaned of soft parts and hardened. Later the tibia was sawn longitudinally. It shows the great sclerosis of the newly formed cortex typical of chronic osteomyelitis. In the head of the tibia about the area of the former epiphysis is an area of recently formed dead bone, with irregular margins extending in all directions but not yet broken down into pus. In the center of the bone leading from this area down into the old medullary cavity were winding passages and cavities containing pus, but with no complete cloacæ opening into the soft parts around the bone until the solitary opening in the lower third was reached. The intermittent character of the discharge of pus from this opening was probably induced by the varying pressure of the pus within the bone, and the recently formed dead bone in the head of the tibia—which had shown tenderness—was probably the result of this same retention of pus.

The lower articular surface of the tibia seemed completely fused with the talus, no joint surface being found on section; the lamellæ of cancellous bone of the tibia extending down into the talus.

Microscopic sections were made from bone taken from the old epiphyseal areas at each end of the tibia. No cartilage cells were found, the original epiphyseal area being completely obliterated and occupied by cancellous bone as one would expect to find in a man of this age. In the sequestrated area of the upper epiphysis, dead bone was found, not yet undergoing absorption.

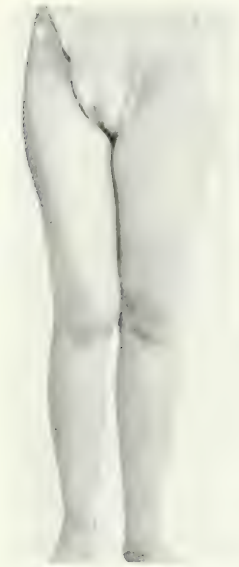

Fig. 8

Fig. 9

Fig. 10.

Fig. 8. Case 3, showing length overgrowth of the right leg, with its smaller musculature. The increase in length appears to lie in the right femur as noted by the marked anterosuperior iliac spines.

Fig. 9. Pelvis and femora of the third patient. The right femur is found to be much longer than the left.

Fig. 10. The legs of the third patient. The right tibia seems a little longer than the left and the head of the right fibula is a greater distance from the plane of the knee joint than on the left side. Some of the joint changes on right side are seen, the narrowing and depression of internal tuberosity of tibia. The bone is not so sturdy as left leg bone.

Case 2. S. J., female, colored, 5 years old. About a year ago she developed an acute osteomyelitis of her left shin bone, for which a delayed operation of drainage was performed. How extensive this operation was it is not possible to state. The bone continued to be painful and discharge pus, lately only intermittently through a sinus on the anterior surface of the lower third of the shin.

This child seemed in good general health on hospital admission and presented uniformly negative findings except for her left leg. The Wassermann test was negative. This left leg was longer than the right leg, but with little atrophy of the thigh and with knock knee and anterior bowing and a slight increase in size of the left shin which seemed to be entirely thickened, roughened bone. There were old scars over the middle of the anterior surface of the shin and one sinus discharging thin pus. Her temperature and pulse were normal. The range of motion of the left knee and ankle was normal and painless. X-ray examination showed a much thickened and denser tibia than normal. There were several areas of apparent cavity formation in the shaft of the bone. No gross roentgenographic changes were noticeable in the epiphyses of this tibia as compared with its fellow tibia except the general greater density of that bone everywhere present. The epiphyses have not closed.

Leg measurements were made:

	Left leg	Right leg
Anterosuperior iliac spine to internal malleolus	21 7/8 inches	19 7/8 inches
Superior border of patella to internal malleolus	11 2/8 inches	10 3/8 inches

A carefully made roentgenogram showed that practically all the lengthening was in the affected tibia, the patellar border measurements being uncertain on account of changed relation of the insertion of the patellar tendon.

Some time later this left tibia was exposed and a wedgeshaped piece of the shaft was excised from one

epiphyseal area to the other. The cortical bone was found to be very dense and thick and was deformed by anterior bowing and only one cloaca was found, near the persisting sinus. The original medullary cavity of the bone seemed to be nearly obliterated. There were small cavities containing pus and granulations, conforming to the X-ray evidence. Near each epiphysis was found pus, but no other gross change was discernible in these areas. A small amount of bone was removed from the upper epiphysis for microscopic study, and the wound on the leg was left widely open. The child is now convalescing.

Microscopic sections from cancellous bone removed in the juxta-epiphyseal areas show merely inflammation of bone. Because the epiphyses appeared quite normal in the roentgenogram, I did not feel warranted in removing any of the cartilage plate, even for microscopic study, fearing a spread of infection with possible unhappy result.

Case 3. M. N., female, age 19. When this woman was 2 years old she caught her right leg and knee between the spindles of a stair rail. Before she could be helped she wrenched her leg free from its position. Acute swelling of the knee joint with loss of use followed immediately. Her parents were told that there was "water on the knee" and eventually as the swelling did not subside, the leg was put in a plaster-of-Paris dressing. Later pain and loss of range of motion developed in this knee and the child walked with lameness. She was then, over a course of several years, treated by injections into the joint after a diagnosis of tuberculosis of the knee.

At her examination it was found that, although her lameness had been attributed to a shortening of the injured leg, this leg was really longer than the opposite leg. She complained of pain in the knee joint after excessive use; none after rest. The knee joint seemed to her to be slightly swollen and her leg was somewhat clumsy. The reactions after the many joint injections had always been painful. The left knee and leg were normal. The right thigh showed some atrophy in its whole length, but there was no paralysis of any muscle. The knee joint appeared full in front but there was no fluctuation in the joint, the apparent swelling being the result of a beginning posterior subluxation of the tibia on the femur. The leg could be passively and actively flexed nearly to a right angle and extended to 170° without any pain. Jars of the joint were also painless but long use set up pain. There had never been any sinus or discharge from the knee or leg. A general physical examination was negative except the right leg, which bore no scars.

Measurements made showed that the whole right leg was 1.5 inches longer than the left. When the thighs were measured from anterior superior iliac spine to the lower border of the patella there was the same difference of 1.5 inches, the right being longer. The legs, as from the lower patellar border to the internal malleolus, seemed to be of equal length. She was unable to extend completely the leg on the thigh. Before the roentgenogram was taken, it was felt that the total increase of 1.5 inches in length of the leg lay in the femur. The roentgenograms showed considerable difference in size of the bones in the right leg as compared to the left. The bones were larger, probably because they had been called upon to perform most of the work of weight bearing. She acknowledged that for many years she has had to favor her leg in use. The spine and pelvis were found to have compensatory changes allowing for the longer limb, so that she walked quite uprightly with level shoulders, but with lameness.

Around the knee joint from the epiphyseal area of the femur, including the patella and the head of the tibia, there were marked changes of osteo-arthritis with new bone formation. On lateral view the joint surface seemed obliterated but the anteroposterior view showed a clear joint surface considerably narrowed, however, as compared to the normal knee. This is partly the result of the mild degree of subluxation present.

The epiphyses appeared to be closed. The transverse axis of the knee joint was slightly tipped, the inner tuberosity of the tibia appearing broadened and flattened down a bit. On the joint surface of the internal femoral condyle appeared a faint line as though a small fragment of bone and cartilage had been separated. The tibial spines were fairly clear. There was no evidence of cavity or sequestrum formation in the joint ends of the bone and only a very slight evidence of sclerosis on the outer sides. It is noticed, however, that the distance from the head of the fibula of the injured leg to the knee joint surface of the tibia is much greater than in the normal joint, as if the tibia had grown on away from the head of the fibula. This would appear to negative in part at least the clinical finding that practically all the increased leg length lay in the femur. The stimulating result of the trauma and subsequent blood effusion and joint injection appeared to have influenced both femur and tibia to overgrowth, the former more than the latter. The soft parts showed a shrinkage.

Here are three instances of overgrowth of a leg; of long bones. In two we find distinct evidence of an acute infectious process involving the shaft of the tibia, starting in childhood. In the first patient after 38 years, there was an appreciable lengthening limited to that part of the limb at first involved. There was a fresh area of dead bone in the upper epiphysis at the time of amputation—too late to have any bearing on long since ceased growth. The *lower* epiphysis had fused in with the talus.

The second patient, only 5 years old, showed a marked overgrowth in the infected bone after 1 year. But neither epiphysis seemed directly

involved, although pus and granulations were found near them. The third patient probably suffered a trauma to the femur (or tibia, or both) at the tender age of 2 years. Probably the lower femoral epiphysis was started out of its place—certainly enough to induce a quickly forming hæmarthrosis. By use and irritation, especially later irritation during the growing period by injections into the joint, an overgrowth resulted. Whether the epiphysis of femur and tibia took on excess growth because of the original trauma and had that action prolonged and aggravated by the chemicals injected into the joint and there absorbed, cannot be stated. But overgrowth far exceeding any natural difference in limb length, coupled first with inflammation, possibly tuberculosis, new bone formation, and later with restricted motion and possible bone separation in the joint surface with beginning subluxation, has resulted.

Was the irritant in the first two patients chemical and toxic yet stimulating, the results of pyogenic products, and was the irritant in the third patient trauma or trauma plus irritation of slightly misplaced epiphysis with blood effusion, chronic inflammation, and chemical injection? I am eager to know. Reverting again to Macewen's ideas on bone growth we might consider that the mechanics of the lack of use had some bearing on the lengthening.

The bones being freed from complete weight bearing, lay for long periods without mechanical use. We notice constantly that this leads to atrophy of disuse with lessened bone density, that is, loss of calcium salts. But these same bones which may undergo atrophy of disuse when lying so long without exercising their supporting mechanical function might respond very readily to stimuli which would lead to overgrowth in length. It is noticed that adolescents confined to bed for long periods, on account of acute illness, will grow in height an astonishing amount in a short period of time. This may also explain why the companion bone (fibula) grows along at the same rate of overgrowth, although it is not infected. It is also possible that it is dragged along by the tibia through its attachments.

TREATMENT

For overgrowth, apparently dependent upon osteomyelitis, we can advise simply adequate treatment of the osteomyelitis with attention to avoidance of contractures and *with early restoration of weight bearing*. If the patient is very young, as my second patient, a portion of bone shaft might be resected in another bone (femur) to equalize the leg lengths if non-union following resection of the infected bone were to be feared. This would avoid the other skeletal changes involving pelvis and spine. If the patient has reached maturity and no further bone growth is expected, the skeletal changes are probably permanent and no equalization of limbs would restore them to normal. Attention in such an instance might be directed toward increasing joint function if it were interfered with. Amputation would be considered only in the long-standing intractable cases with serious complications and as a life-saving measure.

CONCLUSIONS

1. Overgrowth of long bones apparently may follow infections of those bones, the infections not necessarily involving the epiphyseal areas.

2. Overgrowth of long bones apparently may follow epiphyseal displacements, of even slight degree.

3. Every patient with osteomyelitic epiphyseal disturbance of long bones should receive an early diagnosis and thorough conventional treatment, and each patient should be warned that growth disturbances, either undergrowth or overgrowth may result. Use and weight bearing on the limb should be restored at the earliest possible moment.

FIBRO-LIPO-SARCOMA OF THE SPERMATIC CORD

BY THOMAS H. KELLEY, M.D., F.A.C.S., CHICAGO

CAREFUL survey of the literature reveals comparatively few cases of spermatic cord tumors, and for this reason the following case is presented.

The patient, a switchman, age 47, came under observation in November, 1920, with the history that 6 years previously, while working as a switchman, he was injured in the left inguinal region. Shortly afterward a small hernia appeared at the site of injury. He was operated on, the sac located and ligated, and the hernia repaired according to the usual technique. He was free from trouble for 4 years, when he noticed a very hard swelling in the left scrotum. This gradually increased in size and at the time he came for examination the tumor was about 6 inches long and 4 inches wide. It was hard, not painful on pressure, no impulse could be felt, and the transillumination tests were negative. The tumor mass and induration of the spermatic cord seemed to extend as far as the external ring, although the main body of tumor was in scrotum.

Operation was performed November 19, 1920. An incision was made in the scrotum over the tumor mass through the dartos and tunica vaginalis. Apparently two or three other sacs were cut before the tumor mass became visible. The tumor mass was aspirated but no fluid obtained. The testicle was found on the inner side of the tumor and except for a slight increase in size, was apparently normal, but the cord and vessels were hopelessly lost in the tumor mass itself. The incision was carried upward through the external ring into the inguinal canal. Here a slight peritoneal sac was found. The sac was opened but no bowel or omentum could be found. The sac was ligated and dropped back into the abdomen. The entire cord was cut transversely at the inguinal canal and removed with entire tumor mass from scrotum, and testicle was also removed. The bleeding points were ligated and dartos and skin sutured. The tumor is the shape of a kidney with the hilus in which the blood vessels enter. It is pale yellow, smooth, and covered by a thin, transparent, glistening membrane. It is hard and resists considerably to cutting. It is 14 by 9 by 9 centimeters and weighs, with the testicle included, 1½ pounds. The cut surface shows the upper one-fourth of the tumor to be very firm and pink, and the lower three-fourths less firm and pale yellow, but there is no definite line of demarcation. The pale portion is divided by fibrous septa into small lobules of about pea size. The testicle is free and slightly larger than normal, and the cord runs along the hilus of the tumor and is slightly enveloped by the tumor mass in the upper portion; however, the cord can be resected and is not included in the tumor proper.

Microscopical description. About three-fourths of the tumor mass has the character of a lipoma, but there are fibrous septa running into the tumor mass which show a sarcomatous infiltration. The rest of the tumor mass is a mixed cell sarcoma with abundant deposition of collagen fibrilli which show in scattered portions hyaline changes. Even the more solid tumor mass shows areas of lipomatous tissue scattered in places. There is a fairly good blood supply. The cells vary greatly in size, shape, and staining properties. The predominating cells are small, round cells. Some of the nuclei stain faintly and some very deeply. There are cells with huge, faintly staining nuclei about 12 microns in size; and also cells with an irregular, deeply staining cytoplasm. Atypical mitosis can be seen in numerous places. The testicle shows a marked increase in interstitial cells. The epididymis shows a proliferation of epithelial lining.

Diagnosis. Fibro-lipo-sarcoma, the lipomatous element predominating.

Tumors of the spermatic cord are comparatively rare and very little is known of their etiology. Lipoma, myoma, myxofibroma, dermoid cyst, sarcoma, and carcinoma are the ones most frequently met with. Hæmatoma of the spermatic cord has been reported. Of the benign growths, lipoma is the most common, while sarcoma occupies first place in frequency among the malignant growths.

Numerous theories are advanced regarding the etiology. Some authors claim that injury is the predisposing factor, others state that these tumors are secondary to similar growths in the testicle, and still others believe that the primary origin is in the cord itself. In 1909 Patel and Charlier made an exhaustive study of tumors of the spermatic cord and collected all the cases reported up to that time. They were able to find only 73 cases, of which 39 were lipomata, 4 mymota, 12 fibromata, 13 mixed tumors, 4 sarcomata, and 1 carcinoma.

In 1916 Brand[1] reported a primary perithelial sarcoma of the spermatic cord in a patient of 28, who complained of joint pains, and pain and swelling in the left testicle. An orchidectomy was performed. Two months later another growth appeared in the same location. At the end of a year he returned for

[1] Brand, A. New York M. J. [illegible]

operation and at this time the scrotum seemed to contain two testicles; one was a mass the size and shape of a small egg in the stump of the left spermatic cord. The glands were not enlarged and the Wassermann test was negative. The tumor was removed and the patient made a rapid recovery. Pathological examination proved it to be malignant. As a very thorough examination of the testicle removed at the previous operation showed no malignancy, Brand assumed that the growth originated in the cord itself, possibly the result of the trauma produced by the suppurative process in the testicle and the surgical intervention.

Fox[1] reported a dermoid cyst of the spermatic cord in a young negro, who complained of joint pains, fever, sweats, and small, painless swelling in the inguinal region. This swelling finally reached the size of a pear. The tumor contained about 4 to 4½ ounces of white, flaky material and a lock of golden hair. Pathological diagnosis, dermoid cyst.

Schuzler[2] in 1916 reported a myoma of the spermatic cord in a man of 52 with a negative history excepting a hernia in childhood. At operation the tumor was revealed inside the tunica dartos and the vaginalis communis, bound down by several layers of taut membrane. Behind it was the vas deferens running unhindered down to the bottom. The tumor was round, rather knotty, weighed 62 grams, was the size of an apple, with almost the consistency of cartilage and was enclosed in a hard capsule. When cut it showed a light red color and was entirely solid, very much like a fibroma. Schuzler believes it is not possible to distinguish clinically between various intrascrotal tumors with absolute certainty and that any tumor of the spermatic cord should lead one to think of a myoma, no matter what the origin.

Lipomata of the spermatic cord were discussed rather fully by Schiller[3] in 1918, while Pluyette, and Bertin[4] reported a case in a man of 35 with a family history of hernia. The tumor was about the size of a walnut and painless. At operation it was found to be an extra-inguinal lipoma occupying the middle part of the cord.

Mayer[5] reported a myxofibroma of the cord in a man of 41 who had had a right-sided cryptorchism since childhood and at the time of examination was suffering from pulmonary tuberculosis. In 1917 he noticed a painless lump in the right inguinal region. A year later the tumor could be felt fluctuating both against the ground and the skin. A fibroma of the cord was diagnosed, with possibility of malignancy considered. Operation showed the tumor to be freely movable, together with cord. It was about 5 by 5 by 4 centimeters in size, with little lumps over the whole surface, and enclosed in a thin, transparent capsule. Incision showed that it was made up of clearly separated lumps, 1 to 3 centimeters in diameter. Microscopic diagnosis: myxofibroma.

Hæmatomata of the cord are of interest because they are so likely to be diagnosed as strangulated epiploic hernia. Martin reported two cases in 1919 and emphasized the necessity of a careful differential diagnosis.

The operative treatment in all tumors of the spermatic cord is complete enucleation. In the benign variety, the testicle and vas deferens can be retained while in malignant cases removal of these organs is usually necessary. According to Kocher, tumors of the cord can be divided into those located higher up, being only loosely connected with the wall because of a defect in the serosa, and those situated farther down in a limited portion of the tunica vaginalis, developing either into the spermatic cord or outward or even diffusely located in the propria testis and more or less covering the scrotum. The operative treatment, therefore, depends on the location and relation of the tumor to neighboring parts.

Little is said regarding the prognosis of these tumors. In the cases reported, no mention is made of unfavorable terminations. It is likely that the benign variety do not recur after having been completely removed and that the malignant type follow the same rule as do malignant tumors in other parts of the body. In our case there was no return of the tumor or evidence of metastases at time the case was reported, 2 years after operation.

A STUDY IN PUERPERAL MORBIDITY[1]

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Fellow in Obstetrics, 1921-1922

IN the study of the incidence of morbidity in puerperal cases, it has been possible to cover a period roughly approximating 15 years, with a few cases from the year 1906, and practically all the cases following that up to and including 1921. There has been an effort to exclude all those case histories which do not have a rather careful description of the delivery and a record of puerperal temperature range. The result is that there were found available some 7,000 case records, evenly divided between house and out-practice. Of the 3,500 house cases, almost exactly 1,700 are primiparæ and 1,700 multiparæ, so that in all totals made the ratio has been considered equal. Among the out-practice cases, the ratio is about one primipara to four multiparæ, giving 700 primiparæ and 2,800 multiparæ in cases studied.

The purpose of the study to be made was two-fold. First of all there has been a careful statistical study of the incidence of morbidity in puerperal patients, with percentage estimations. There has been throughout a comparison of house and out-practice cases, and a comparative study of the three 5-year periods included in the time covered. In the second place, the purpose of the study is to analyze the cases of morbidity as to etiology, type of case, and mortality rate. Certain explanations are necessary, then, before any analysis of figures is made. The morbidity standard chosen is the English one and includes as morbid every case in which there is a rise of temperature to 100° F. or more for three successive days or longer. This standard quite definitely rules out a small class of cases where there has been a rise of temperature of only 1 or 2 days, but a temperature which seems puerperal in origin, nevertheless. On the other hand unless the 3-day standard be adopted, there would of necessity be so much ruling out of cases that clear-cut study would be impossible. In this connection all that will be said concerning the ruling out of cases in our study is that only an occasional non-obstetrical cause for temperature increase during the puerperium was found, and thus only an occasional case history ruled out.

In the grand total of 3,500 house patients, then, there have been found 300 cases of puerperal morbidity, a percentage morbidity of 8.6. Of these, 202 were primiparæ and 98 were multiparæ, a percentage incidence respectively of 11.5 and 5.6. In other words, puerperal morbidity is practically twice as common among primiparæ. Mortality in these house cases totaled 10—that is 10 whose deaths were due to puerperal sepsis. But it is only fair to state in passing that there has never been a death in the home caused by sepsis, and that among 3,000 deliveries, the records of which were not available for this study there is no other case of mortality from septicæmia. That is to say the 10 in 10,000 is the incidence of mortality from puerperal sepsis in all of the patients delivered since 1906.

On the out-practice there were 71 cases of morbidity in the total of 3,500, an incidence of 2 per cent. Twenty-three were primiparæ and 48 multiparæ, in spite of the fact that four times as many multiparæ were delivered during that time. Comparative percentages here are 3.2 per cent among primiparæ and 1.7 per cent among multiparæ.

Just a word as to the lower rate of occurrence among cases delivered in the home would not be amiss. It must be remembered that temperature records are made at least three times a day in the hospital, while only one visit a day is made to the average patient in the home. Then, too, the tendency has always been for any patients who are seriously ill to be moved from the home to the hospital, and the out-practice morbidity rate thereby decreased. Entirely aside from these somewhat mechanical factors, however, there is a well-known immunity, if you please, among the class of puerperal patients found in the average hospital, or teaching out-practice. Some one has said that the dirt in the home

From the case records of Department of Obstetrics, Woman's Medical College of Pennsylvania, and Maternity Department of the College Hospital.

of the very poor is dirt, while the dirt in the hospital is germs, and that is about as scientific a dismissal of the facts as can be made.

Coming to a study of totals during each of the 5-year periods, the findings are as follows: In the house the first period yielded 740 available case records with 75 cases of morbidity, a percentage of 11.3. In the second period there were studied 921 case histories, with 90 morbid records and a resultant percentage of 9.7. The last period, ending with 1921, gave a total of 1,839 cases, 134 morbid ones, or 7.5 per cent. On the out-practice the first period gave 30 morbid cases in a total of 1,392, a percentage of 2.16. The second total was 21 morbid cases in 1,030, or 2.03 per cent. In the third period 1,078 records were examined, 18 morbid cases found, a percentage of 1.6. In other words, there has been a definite decrease in the incidence of puerperal morbidity both in the house deliveries, and those of the out-practice.

TABLE I.—GRAND TOTALS OF ALL CASES

	House			Out-Practice		
	Totals	Morbidity	Per cent	Totals	Morbidity	Per cent
Totals	[illegible]	[illegible]	8.6	[illegible]	71	[illegible]
Primiparæ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Multiparæ	[illegible]	98	[illegible]	2800	48	[illegible]
1906–11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1911–16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1916–21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Turning next to a division of cases studied into operative and non-operative deliveries, we find that there were altogether 2,886 non-operative deliveries in the house. Of these 161 showed a rise in temperature, a percentage of 5.5. Two of the fatal cases found resulted from non-operative deliveries. Of the 161 morbid patients 107 were primiparæ, and 54 multiparæ, giving percentages of 7.4 and 3.8 respectively. On the out-practice, 3,287 deliveries were non-operative and 54 of these morbid, 1.6 per cent. Fifteen primiparæ and 39 multiparæ gave respective percentages of 2.25 and 1.5. That is to say that in this division, as in the cases of all types, there is almost twice the morbidity with first deliveries that there is with second or later.

Among these non-operative deliveries, 627 of the house cases came in the period ending 1911, and of these 47 ran a morbid course, giving 7.5 per cent as the ratio. In the second period 761 patients were non-operative, 53 were morbid, and 6.9 per cent was the incidence. The third period gave a total of 1,498 patients and morbidity of 58, or 3.8 per cent. On the out-practice there were 1,315 normal deliveries with a morbidity of 24, or 1.8 per cent, before 1911. From 1911 to 1916 there were 959 cases with 15 morbid patients, a percentage of 1.5. And in the last period 1,013 records yielded 13 morbid cases, 1.28 per cent of the total. Here again, then, we find a definite steady decrease in the incidence of morbidity in each succeeding 5-year period.

TABLE II.—NON-OPERATIVE CASES

	House			Out-Practice		
	Totals	Morbidity	Per cent	Totals	Morbidity	Per cent
Totals	2886	161	5.5	3287	54	1.6
Primiparæ	1113	107	7.4	667	15	2.25
Multiparæ	1113	54	3.8	2630	39	1.5
1906–11	627	47	7.5	1315	24	1.8
1911–16	761	53	6.9	959	15	1.5
1916–21	1498	58	3.8	1013	13	1.28

Before turning to the study of operative cases, let us make some investigations of the patients who delivered themselves but who nevertheless ran a morbid course during the puerperium.

Of the 107 primiparæ, 19 had labors which would be called prolonged that is the second stage was more than 2 hours, or the first stage 20 or 24 hours or more. There was no effort to study the incidence of dry labor, but it undoubtedly had its effect. Dorman and Lyon made a study of some 300 cases of dry labor at the Woman's Hospital in New York and found an increase in morbidity from the general average of 17.5 per cent to 26 per cent in these 300 cases. (Report on Scientific Work of Surgical Staff of Woman's Hospital, 1920.) The 19 cases of prolonged labor give a ratio of 19 per cent, and certainly not one case out of five in all non-morbid primiparæ would have second stage of more than 2 hours. As to multiple vaginal examination, 18, or 17 per cent of the 107, had four or more examinations made, a ratio of one to six. And those of us who continue to prefer vaginal examinations must pause at that, for again it seems

improbable that in the general run of cases one primipara out of six has four or more vaginal examinations after she has fallen into labor. There is, then, just a warning in the figures found, low though they seem, and a lesson to be taught in that prolonged labor and repeated vaginal examinations certainly have an influence in increasing morbidity during the puerperium.

But gonorrhœa plays the largest part in this morbidity, and the numbers of the cases found were as follows: There were 23 cases where the bacteriological smear was positive, and 16 where the clinical diagnosis was such that no mistake could be made. This total of 39 cases is a ratio of 36 per cent showing morbidity because of presence of gonococcus. The significant factor here, too, is that there are very few, only 4 or 5, of the group of 39 which overlap the group mentioned above. That is to say that prolonged labor and repeated examinations are by no means necessary to produce a flare-up of gonorrhœa.

One or two examples of each type of case might be given.

This patient is one in whom one might expect a morbid puerperium.

Case No. 780. B.B., 18, para-I, colored, single. Position and presentation: vertex, left occipito-anterior. Labor: first stage, 48 hours; second, 6 hours; third, ¼ hour. Vaginal examinations: four in last 24 hours. Delivery: spontaneous. Temperature: 103, 102, 100.2, 101, etc. from third to sixteenth days. Symptoms: localized pain and tenderness, subinvolution.

Another:

Case No. 1450. M.B., 18, Irish, married. Position and presentation: vertex, right occipito-anterior. Labor: first stage, 10 hours; second, 1 hour; third, ¼ hour. Vaginal examinations: four in last six hours. Delivery: spontaneous. Temperature: 103.1, 102.1, 101.2, 103.1, 100.1, 101.1, 99.2 on fourth to tenth days. Symptoms: abdominal pain and tenderness; subinvolution.

One typical gonorrhœal case may be quoted.

Case No. 877. F.W., 18, para-I, colored, married. Presentation and position, vertex, left occipito-anterior. Labor: first stage, ?; second, 2 hours; third, 20 minutes. Delivery: spontaneous. Vaginal examinations: one. Temperature: 103.2, 104, 103.1, 104.3; 104.3, 103.4, 102, 101.2, 101.2, 102.1, 101.1, 99, 98.2 on fourth to sixteenth days. Symptoms: very slight abdominal distention, no pain, general condition excellent. Cervical smear: Gram-negative diplococci, intracellular, morphologically gonococci.

One other type of case must be mentioned, although most careful search revealed only three which could be included. That is the case in which a diagnosis of pyelitis can be made—manifested by pain in back, some pain on micturition, and usually a tendency to chill at the time of temperature rise, with findings of pus in the urine. In the cases of our finding which can be included here, one had a definite cystitis before delivery, and in the other two there was no evidence of influence upon course of the case by prolonged labor, many examinations, or bacterial invasion of uterus of cervix.

Phlebitis, of course, claims a few, but here again the number is small, only four being found in which such diagnosis was made.

Just a word as to the very serious cases and those in which death occurred. In Jellett's *Midwifery* there is the following rather telling quotation from Smyley: "If a patient with a high temperature looks well, sleeps well, and says she is well, she is, at any rate, not septic. If a patient with a high temperature looks very ill, sleeps very badly, and says she feels very ill, she generally is very ill. If a patient with a high temperature looks very ill, sleeps very badly, but says she feels very well, she will probably die." With that as something of a standard, there are few cases in the non-operative class which can be considered serious. The charts of some of the 8 gonorrhœal cases look startling, with temperatures of 105, 104, or even 106 or 107, as no uncommon findings, but almost as startling is the regularity with which the resident has noted no symptoms, or failed to note even the temperature at all in her record because the patient herself refused to admit that she was ill. Therefore, so near as we can judge, the seriousness of the case by the combined impression of the temperature chart, and the faithfulness of the resident in making unusually careful daily notes on her most seriously ill patients, we find only four cases which it seems permissible to call serious infections.

Two of these were fatal. Of the other two, one ran a high septic temperature for a week, developed a septic rash, but went on to recovery. The second had a septic temperature for 2 weeks, had frequent chills, much abdominal pain and tenderness, and also a septic rash. She too went to recovery. The first of the fatal cases was one in which there was a definite kidney condition before delivery. She delivered herself without difficulty, but on the fourth day of the puerperium developed a typical streptococcic septicæmia, which caused her death on the eleventh day. The second patient showed no prenatal complication, and delivery was normal and very easy. She, too, had a typical streptococcic infection in which double lobar pneumonia was the terminal condition, but which was undoubtedly puerperal in origin.

Such an analysis as the above leaves some 35 cases of morbidity unaccounted for in any way, 33 per cent of the primiparæ. These are those patients who were delivered after short, easy labors, or self-delivered, with no evident reason for infection. But they are, nevertheless, definitely a part of every maternity ward's morbidity statistics and as such stand as the unsolved problem in those statistics.

In a little less detail, let us look at the 54 multiparæ, non-operative, who ran morbid temperatures in the house. Among these, there is no evidence whatever of prolonged labor or repeated examinations as a factor, and only some three or four had more than two examinations. There are not many cases which can be called serious either, and no fatalities. One patient who had a smear showing gonococci had a subsequent peritonitis which was serious but recovery followed. Another had an unidentified infection which caused a definite peritonitis of 8 days' duration, but her recovery was rapid. The third serious case showed a positive blood culture, and clinical evidence pointed to fresh vegetation on the aortic valve. But she, too, recovered, though she was in the hospital 6 to 7 weeks, and had not too good a heart on discharge.

Eight of these patients showed a positive smear for gonococci, one had pyelitis, and two seemed to have had retained clots which accounted for the temperature range. There are, therefore, 38 of this group, 66 per cent, who ran mild courses, but who stand in the problematical group of puerperal morbidity.

On the out-practice conditions are much the same:

Of the 15 primiparæ there were 3 cases positive of gonorrhœa, 2 clinically positive, while long labor was present in 2, and more than four examinations were made in 4 cases. There were no serious cases and there are about 8 where the etiological factor for increased temperature is unknown.

The 39 multiparæ records are as follows: There were no serious cases and no fatalities. In two and four cases respectively there is a history of long labor and more than four examinations. Three patients had positive smears, and six ran courses clinically gonorrhœa. As for the other 25 cases, 66 per cent, there are various reasons for fever, evolved by fertile brain of student or interne, varying from dietary indiscretions, and alcoholic intoxication, to doing family washings on third or fourth day of puerperium. Whatever the explanation made, here again are those unaccounted-for cases which remain in the category of the unknown.

In the field of operative deliveries we find the most frequent occurrence of patients whose temperature is increased during the puerperium. In the house during the time covered there have been 614 patients for whom operative procedures were necessary, 351 of them primiparæ and 263 multiparæ. One hundred and forty-one of these 614 patients are classed in the morbidity group, or 22.9 per cent. Of the 351 primiparæ 26.5 per cent were morbid, and 18 per cent of the multiparæ. Eight of the 10 fatalities mentioned before occurred following operative procedures on house patients, or patients who died in the house.

Two hundred and thirteen out-practice patients underwent operative deliveries or procedures of various sorts: 40 primiparæ and 170 multiparæ. The percentage morbidity was 8 per cent as a total, or 17 patients. Eight primiparæ yield a percentage rate of 20, as compared with 9 multiparæ and 5.3 per cent.

Comparing the 22.9 per cent incidence in the house with the 8 per cent on the out-practice it looks three times as safe to resort to operative procedure in the home. But there is the important point always to be considered that so far as possible the more serious procedures are done only in the house, and of course all cæsarean sections come in the house statistics. But even discounting all of that, there is the same factor of immunity if it can be so called, among the patients in slum districts which we mentioned above.

In the 5-year period there has been less decrease in postoperative morbidity than in either of the other comparisons made. Of 113 house operations before 1911, 28, or 24.7 per cent, caused morbid puerperia. From 1911 to 1916, 37 out of 160, or 23.1 per cent, came into the morbidity statistics. And in the last period 76 out of 341 make the percentage 22.2. On the out-practice 6 of 77, or 8 per cent; 6 of 71, or 8.4 per cent; and 5 of 65, or 7.7 per cent, are the figures.

TABLE III OPERATIVE CASES

	House			Out-Practice		
	Totals	Morbidity	Per cent	Totals	Morbidity	Per cent
Totals	613	141	23	214	17	8
Primiparæ	351	93	26	40	8	
Multiparæ	262	48	18	174	9	5
1906-11	113	28	24.7	77	6	8
1911-16	160	37	23.1	71	6	8.4
1916-21	341	76	22	65	5	8.7

Some classification of types of operation and the risk attached to each is important. In order of morbidity rate, the house cases are shown in Table IV. The first number in each line is the total number of times that operation was performed, and the second the morbidity, with the percentage following.

The figures as given speak largely for themselves and little amplification is necessary. The sequence found seems quite in line with the teaching one receives. The place of cæsarean section practically midway down the list occasions a little surprise until one remembers that in a clinic where a fairly large proportion of the patients are receiving prenatal care, cæsareans are rather regularly performed without endangering the patient's recovery by unwise management before the section is

TABLE IV.—HOUSE CASES

	Operation	Morbidity	Per cent
Intra-uterine packing	9	6	66⅔
Intra-uterine douche	14	8	58
Version and extraction with craniotomy	12	6	50
Multiple (three or more procedures)	21	9	43
Manual removal of placenta, following other procedure	88	31	35
Insertion of bag followed by other procedure	32	12	38
Cæsarean section	42	16	38
Version and extraction	88	25	28
High forceps	85	22	26
Mid-forceps	68	17	26
Breech extraction	85	15	18
Low forceps	123	17	10
Manual removal of placenta	46	5	10
Insertion of bag	59	3	5

TABLE V.—OUT PRACTICES CASES

	Operation	Morbidity	Per cent
Intra-uterine douche	5	2	40
Version and extraction with craniotomy	3	1	33⅓
Manual removal of placenta following other procedure	31	5	16
High forceps	28	3	11
Mid-forceps	27	3	11
Manual removal of placenta	55	5	9
Low forceps	31	1	3
Version and extraction	10	1	10
Breech extraction	42	1	2.4

decided upon. Even so the mortality risk to be discussed later puts a little different light on the subject. The comparative innocuousness of manual removal of the placenta, especially in the house is hardly to be expected if one reads various textbooks in obstetrics, with their dire warnings against that procedure.

A discussion of the various individual cases in the operative field would be of interest. But each is so different from each other that typical cases cannot be cited. Suffice it to say that gonorrhœa plays its large part here, too, as an etiological factor in rise of temperature. And pyelitis, phlebitis, and severe generalized infections are present. The severe cases are much more frequent than in the non-operative field, and the recovery of some of the patients seems most remarkable. But here again there is a host of case records in which a questionmark is the only cause recorded for the fever of the puerperium.

Just a word must be said of those patients who died of sepsis following operation. In point of numbers the operations follow:

Intra-uterine packing	2 of 10
Version and extraction with craniotomy	1 of 12
Cæsarean section	2 of 42
Breech extraction	1 of 85
High forceps	1 of 85
Version and extraction	1 of 89
Post-partum curettage	1 of 1

In two of the above cases manual removal of the placenta was done in addition to operation listed and in two more some third procedure had been used. The only comment that seems necessary is to call attention to the fact that in 8 out of 10 fatalities there was an operative delivery, and that the operative procedures were in almost all cases of the more prolonged and serious type. In other words, these few fatal cases teach even more emphatically than do the morbidity statistics that operative deliveries are dangerous, and are highly undesirable if we are anxious over mortality or morbidity statistics among puerperal patients.

CONCLUSIONS

1. Total morbidity was 8.6 per cent in house and 2 per cent in out-practice cases.

2. Morbidity was nearly twice as common in primiparæ as in multiparæ.

3. Total morbidity percentages have shown a steady decrease by 5 year periods both in house and on out-practice.

4. Total mortality from puerperal sepsis was 10 in 10,000 cases.

5. Morbidity in non-operative cases was 5.5 per cent of cases delivered in the house and 1.6 per cent of out-practice.

6. There was definite increase in morbidity among non-operative cases in primiparæ as compared with multiparæ, and the influence of long labor and repeated vaginal examinations can be traced.

7. There is either bacteriological or definite clinical evidence of gonorrhœa as an etiological factor in puerperal infection in 36 per cent of the primiparæ and 20 per cent of the multiparæ.

8. There is a large class varying from 33 to practically 75 per cent of the total patients in whom the course of the reaction was very mild and for which no definite etiological factor could be found.

9. Morbidity percentage has shown a steady drop by 5 year periods in non-operative cases, both in the house and on the out practice.

10. Mortality rate has been 2 in 2,886 house cases and none in the out-practice, non-operative.

11. The percentage morbidity in cases where operative procedures were used was 22.9 per cent in the house, and 8 per cent on the out-practice.

12. The incidence of postoperative morbidity was from 2 to 4 times as great in primiparæ as in multiparæ.

13. The drop in the incidence of postoperative morbidity has been less than that of non-operative morbidity, but has occurred.

14. The operative procedures as to morbidity incidence show the following sequence: intra uterine douche; version and extraction with craniotomy; manual removal of placenta following some other procedure; insertion of bag followed by some other procedure; cæsarean section; version and extraction; high forceps; mid-forceps; breech extraction; low forceps; manual removal of placenta; insertion of bag. We find that the sequence on the out practice is practically the same.

15. The operative procedures which have been followed by fatalities have been the more serious prolonged type, and multiple procedures have been common.

TUBAL TWINS AND TUBAL PREGNANCY[1]

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INTRODUCTION

ECTOPIC gestations are classified on the convenient basis of location. Since primary ovarian and abdominal pregnancies are rare and the uterine tube is the natural site chosen, the adjective "extra-uterine" or "ectopic" is usually understood to connote primary tubal implantation.

Besides the ordinary plural pregnancies within the uterus there are occasional cases of plural gestation in one or both tubes, or combined simultaneously in uterus and tube. Seven is the greatest authentic number of uterine births at one time (Parker, 1914); within a tube three and five equal fetuses have been found.

The several types of pregnancy allow of systematic arrangement. The following grouping is suggested as a convenient way of expressing these relations.

CLASSIFICATION OF PREGNANCIES

I. *Uterine*
   1. Simple (i. e., single);
   2. Successive (superfetation);
   3. Twin, etc.

II. *Tubo-uterine* (combined uterine and tubal)
   A. Unilateral (uterus and one tube)
      1. Simultaneous
         a. Twin; b. triple, etc.
      2. Successive
   B. Bilateral (uterus and both tubes)
      1. Simultaneous
         a. Triple, etc.
      2. Successive

III. *Tubal* (including interstitial)
   A. Unilateral
      1. Simple;
      2. Successive;
      3. Twin, etc.
   B. Bilateral
      1. Simple;
      2. Successive;
      3. Twin, etc.

IV. *Ovarian*
   1. Simple;
   2. Successive;
   3. Twin.

V. *Abdominal*
   A. Primary
      1. Simple;
      2. Successive;
      3. Twin.
   B. Secondary
      1. Simple;
      2. Successive;
      3. Twin.

It is suggested that "tubo-uterine" designate a simultaneous pregnancy in both uterus and tube. This would replace such cumbersome terms as "intra-extrauterine," or "combined uterine and extra-uterine." It seems preferable to refer to twins in one tube as a "tubal twin pregnancy," and the fetuses themselves as "tubal twins"; since "twin tubal pregnancy" has been used both as a synonym for the foregoing condition and also to designate the occurrence of one fetus in each tube (bilateral tubal pregnancy), it is better avoided altogether. The inclusion of "successive pregnancies" is necessary to cover those cases in which a second gestation occurs in women already pregnant or still carrying the dead product of a former conception. This introduces the vexed question of superfetation; however, such provision must be made, for this type, although undoubtedly very rare and most records spurious, cannot be ignored as a possibility.

THE LITERATURE ON TUBAL TWINS

The commonest plural pregnancy that involves the uterine tubes is the combined tubo-uterine type. According to Cameron (1906), Vilsin recorded 65 cases (in 25 of which the tubal fetus reached maturity!). In 1905 Weibel had collected over 119 cases, although it is probable that some of these are merely presumptive and not all are twins. Plural

[1] Contribution No. 91

gestation in the same tube is next common. Pulcher (1905) found 18 examples; Costa, in 1907, listed 11 cases which he considered certain and added 15 presumptive cases; McCalla (1909) cites 25 positive cases; Pool and Robbins (1910) give 26 positive cases and reject 18; Hardouin (1919) enumerates 37 as positive and eliminates 13 as spurious. Rarest are bilateral tubal pregnancies. Although McCalla (1909) collected 37 cases and McDonald and Krieger (1913) list 25 proved and 27 probable specimens, less than a dozen of these actually are twins.

In another publication (1923 *a*) I have examined fully the literature of unilateral tubal twin pregnancy and have extracted therefrom 38 positive or authentic cases, 8 probable or presumptive cases, and 4 possible but doubtful cases. The positive list is there increased by two new specimens and critical summaries of all previous cases are appended.

AN ANALYSIS OF TUBAL PREGNANCY

Critical examination of the data of tubal twinning, recorded in full elsewhere (1923 *a*), yields numerous interesting facts;[1] the remainder of this report will be devoted to an analysis of these relations and the inferences to be drawn from them.

1. *Age of the mother.* First to be considered is the age of the mother. What time-relation does it hold to the mean age for ordinary uterine births? A norm may be established from the birth statistics of the United States Bureau of Census. These include the ages of the 4,080,879 women in the registration area (55 per cent of the total population) who became mothers during the years 1917–1919. Converted into percentages such figures may be stated as follows:

Age	Per cent	Age	Per cent
10–14 years	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
20–24 years	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Assuming that the middle year represents with sufficient accuracy the mean for each of these five-year groups[2] it appears that the average age for childbirth in the United States is 26.5 years.

It is interesting to compare these results with those found in 47 cases of single tubal pregnancies[3]:

Age	Per cent
20–24 years	19.2
25–29 years	36.2
30–34 years	23.4
35–39 years	21.3
40–44 years	8.5

The mean age is 31.0 years, or 4.5 years later than the average for normal uterine births. The modal period is between 25 and 29.

If the ages of the mothers (in 41 instances this information is furnished) in my list of tubal twins[4] be similarly tabulated the distribution is:

Age	Per cent
20–24 years	9.8
25–29 years	29.3
30–34 years	39.0
35–39 years	17.1
40–44 years	4.9

The mean age is again 31.0 years, or 4.5 years later than the average for uterine births. The precise agreement in the ages of the mothers of tubal single pregnancies and tubal twins is to be expected since most of the twins are monochorial and the conditions therefore identical. Moreover, there is no divergence in the six cases of double ovum twins for the average of these is 30.9 years. The modal period, however, is between the ages of 30 and 34; this is one group later than in single tubal pregnancies. The grand mean of both single and plural groups (88 cases) establishes 31.0 years as the average age for tubal pregnancies in general. The interpretation of this delay of 4.5 years will be considered (see following page) as soon as certain allied relations have been presented. These facts pertaining to age distribution are shown graphically in Figure 1.

[1] Especially notable as curiosities are the quintuplets of Treub-[illegible]

[2] [illegible] extreme groups introduced by this assumption roughly balance, the computation is doubtless approximately accurate.

[3] In 1915, Mall published a monograph on the fate of the ovum in tubal pregnancy. As an appendix were recorded descriptions and available histories of the 117 specimens that formed the basis of his report. This material represents the tubal pregnancies in the first thousand specimens of the Carnegie collection. Fifty cases which have reasonably adequate clinical histories I have tabulated for use in the present publication. These will be referred to as the "single series" (of tubal pregnancies).

[4] [illegible] cases will be referred to hereafter as the "twin series."

2. *Previous births and abortions.* Equally significant is the number of children already born to these mothers, and the frequency of abortions. In the single series 13 cases state there were no children; the 36 mothers total 71 births. In the twin series there are 8 cases with the absence of children clearly stated; 25 women had become mothers, the number of children equalling 50. Combining these data, which are in essential agreement, it appears that three-fourths (74.4 per cent)[1] of women having tubal pregnancy are already mothers; nearly half (44 per cent) are multipara and the average number of children (to all who are mothers) is exactly two.

Abortions are common. In the single series 33 abortions are recorded for 14 cases; absence of abortion is stated in 21 cases. In the twin series there were 18 abortions in 9 cases; its absence is mentioned in 6. Combining gives a total of 51 abortions in 23 women, 17 of whom were also mothers. It follows that not only abortion but repeated abortion commonly appears in these histories.[2]

3. *The sterile period.* Another important correlation is the elapsed interval since the last pregnancy (normal or abortion), or since marriage among nullipara. In the single series this interval for 44 cases averages 5.6 years; included are 10 women who never before had been pregnant, the mean interval since marriage being 6.2 years. In the twin series (29 cases) the average interval is 6.2 years; seven of these individuals were nullipara, never before pregnant, whose average married life had been 6.6 years. Combining both single and plural sets of 73 cases gives a mean interval of 5.8 years since marriage or the last pregnancy. Of the 17 who had never previously been pregnant, an average of 6.4 years had elapsed since marriage.

The explanation of this sterile interval is a corollary to the explanation of tubal pregnancy itself. Mall's (1915) intensive studies with the unique material at his disposal point clearly to tubal inflammation as the chief factor in tubal gestation. It appears that an

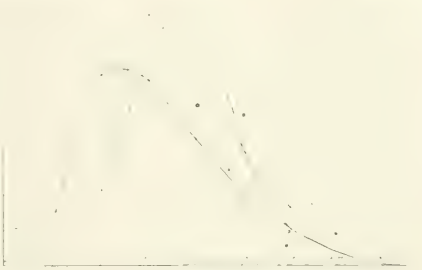

Fig. 1. A graph showing the relation between the mother's age and the percentage frequency of births: ———, single uterine births; – – – – –, single tubal pregnancies; — — — — —, twin tubal pregnancies.

inflammatory condition may prevent pregnancy for a variable period, either by mechanically blocking fertilization or by causing young ova to disintegrate. After a time when the inflammation has largely abated, the tube becomes a possible nidus for the growing ovum, which, nevertheless, is still unable to reach the uterus. If tubal pregnancy does not then occur, it is believed the tube later may become sufficiently healed to allow fertilized ova to pass to the uterus in a normal manner. In other words the chance of incurring tubal pregnancy is least under two extremes; either when the tubes are normal, or when they are so affected as to prevent conception entirely or destroy its product early.

This course of tubal inflammation, for which there is direct proof, adequately explains the prolonged sterile period that so often precedes tubal pregnancy, the consequent greater age of women having such ectopic gestations, and the frequent termination of the sterility by tubal implantation. The preponderance of cases among women who are already mothers and the added facts that two-thirds of these are multipara, evidently signifies that elapsed time and the cumulative hazards of marriage and motherhood are favorable to the acquiring of infections. The relative frequency of abortions, most of which are remote in time, perhaps denotes earlier mild attacks or onset of a condition which thereafter tightened in the tube and caused the period of prolonged sterility.

[1] Whether relatively more histories neglect to mention the absence than occurrence of children is doubtful. Probably the percentage stated is approximately correct.

[2] Many histories give no information on this point so the absolute frequency is obscure. De Lee's (1919) practice has yielded 24 per cent which he considers below the actual frequency.

4. *Summary regarding the mother.* The foregoing analyses may be brought together in a generalization. Tubal pregnancy (single and plural) tends to occur in women who are older by 4.5 years (31.0 years) than the average age for motherhood (26.5 years). These women fall into two groups: (1) Three-fourths are already mothers (but without recent pregnancies) and nearly one-half are multipara; previous abortions are common. (2) One-fourth have been married a relatively long period without becoming pregnant. The sterile period since marriage or the last pregnancy averages nearly 6 years.

5. *Frequency of rupture.* A natural query is whether tubes which bear twins are more likely to be ruptured at the time they come to hand than are single tubal pregnancies. Mall (1915) found, among the records of Dr. Kelley's laboratory, 128 cases of tubal pregnancy carefully described. Of these 82 had ruptured previous to the operation while 46 were unruptured. Furthermore, in the Carnegie single series there are records of 49 ruptured[1] and 49 unruptured[2] cases, distributed unequally among three general groups. The specimens containing normal embryos include 20 with rupture and 9 without; of those having pathological embryos the representation is 8 and 8; the remaining group, which comprises degenerating ova without embryos, yields 21 ruptured cases against 32 unruptured.

It will be noted that the greatest frequency of rupture occurs in tubes containing normal embryos, next come tubes with pathological embryos, and lowest are those without embryos but containing degenerating ova. The percentages of rupture in each of these groups are respectively 69, 50, and 40. This means that a growing normal embryo in the tube is an especial menace due to its greater probability of causing rupture. Embryos which are pathological tend to remain small or to degenerate; the severity and rate of these changes depend on the relative fitness of the tubal mucosa to receive the ovum; in general, the more severe are the conditions inducing atrophy, dissolution, and absorption, the less is the danger of rupture. Manifestly, to indicate the true frequency of rupture the many small specimens wh ch represent ova undergoing atrophy and resorption should be included; these often are not recognized or are believed to be without value or interest. The Carnegie series does include many such, and Dr. Kelley's list of 128 contains 39; when these two sets are combined the ratio of rupture to non-rupture becomes 131:95, or 58 per cent. This represents the best approximation available.

In the twin series with single chorionic sacs, 28 cases mention rupture and 7 its absence. The 80 per cent ruptured at first appear to indicate that tubal twins in the same sac do burst more frequently than single pregnancies (58 per cent). However, this rate is undoubtedly too high, since it is obviously impossible to identify and include as monochorial twin specimens those degenerating ova, without recognizable twin embryos, which rightly belong here. Furthermore, surgeons doubtless fail to identify markedly pathological twin specimens; at least such have not been reported. Since the figures just derived show that less than 50 per cent of tubes without normal embryos rupture, and our list lacks a proper representation of these, the unreliability of the higher ratio of rupture among monochorial twins becomes apparent. Theoretically a somewhat greater frequency might be expected. This, however, would be due to placentation and its sequelæ, not directly to abnormal stretching of the tube by twins, as Martin (1895) feared; at the time rupture is most likely to occur the twins do not even crowd the chorionic cavity (Arey, 1922 a). Various cases corroborate this view. Lucas-Championnière (1903) records twins of 8.0 centimeters in an unruptured sac, while in Braham's (1914) specimen rupture was delayed until during the sixth month. It is also clear that pressure may flatten one or both fetuses without producing rupture; in Robinson's (1892) case both 13 centimeter fetuses were compressed; in Rupin's (1860) there were a 6 months' fetus and the bones of a 4 months' one; Folet's (1896) specimen contained a full term fetus and one of 3 months greatly flattened; Minchinard (1896) described a ruptured tube which had held an 8

months' fetus and a flattened fetus of 6.5 centimeters. The two authentic cases of unilateral tubal triplets (Krusen, 1902; Diamant, 1914) ruptured at about the tenth and eighth week respectively, whereas the average time for single specimens is 7.7 weeks (cf. following topic).

6. *Time of rupture.* Closely associated with the last topic is the time of rupture of monochorial twins and its relation to rupture in single specimens. In the single series the average time of rupture for 25 cases is at 7.7 weeks. The corresponding figure for 28 cases in the twin series is 10.9 weeks. Perhaps the older specimens are more faithfully recorded in the twin series due to the unusual feature of twinning; on the contrary fewer old and bulky specimens are doubtless sent the Carnegie collection than represents the true frequency of distribution. At any rate there is no evidence that tubal twins rupture earlier than single pregnancies, as Martin (1895) assumed; the available data, which may not be entirely trustworthy, indicate the contrary.

7. *Age of the embryo.* The average age of 46 normal single tubal embryos in the single series is 8.0 weeks. In the twin series the mean age of 37 monochorial specimens is 11.6 weeks. If it be assumed that the Carnegie collection contains disproportionately few large specimens, and if, for this reason, all fetuses over 14 weeks in age (i.e., 22, 24, 32, 40) be omitted from the twin series, the remaining 33 still average 9.4 weeks. Why this should be so is not evident unless, as already stated, the older single fetuses are not so diligently preserved.

8. *Fate of the embryo.* The fate of the tubal embryo is varied. A normal, growing ovum rapidly burrows into the wall of the tube and usually perforates it. If rupture occurs into the broad ligament, development may continue even to term. If, on the contrary, extrusion is into the peritoneal cavity, in most cases the embryo will die and disappear. Ova which do not become well implanted in the tube undergo early degeneration, usually without rupture. In many such dissolution is remarkably rapid, the embryo first disappearing and then more gradually the chorionic sac. To this group belong almost all small pregnant tubes, for had the embryos continued growing normally these specimens would have been much larger by the time the condition was recognized and operated upon. Hence one learns not to expect normal specimens in small tubes with histories of 6 or more weeks' advancement. On the contrary some fetuses and their membranes resist disintegration for long periods. Albertin (1903) described 3 months' tubal twins which had ceased growth a year before, yet appear to be well preserved. In Folet's (1896) case unequal twins with cords and a placenta had persisted 15 years uncalcified; one member of the pair was full term, the other at 3 months. Haydon's (1864) specimen was a successive pregnancy which contained a 2 months' embryo, dead 4 or 5 years; in the same category are the cases of Henricius and Kolster (1899) and Coe (1893) who recorded the preservation of fetal bones for 6 years and 9 or 12 years respectively. A most remarkable illustration is that of Varnier (1900) who found a full term litho pedion, cord, and placenta in the abdomen of a woman 75 years old who had carried them for 33 years.

The outcome of the twin pregnancies is recorded in 40 cases. Twenty-nine recovered; 10 died; one was found at autopsy. Contrary to the opinion of Hardouin (1919), who found records of only two fatalities, the novelty of the specimens appears to overbalance any reluctance in reporting unsuccessful operations.

9. *The maternal adnexa.* Mention may be made of some miscellaneous data, chiefly relating to the maternal adnexa in tubal twin specimens. In the single series the position of the tube, whether right or left, is noted in 52 cases. The right tube was involved 19 times, the left 33. The twin series yields information in 36 cases, of which 17 designate the right tube, 19 the left. Combining all 88 cases; 52, or 60 per cent, were on the left side, the remaining 36 on the right. There is no evident reason why this unbalanced ratio should exist although there are suggestive parallels among other animals. Thus in certain skates the left ovary alone functions while in birds the same condition holds, due to the degeneration of the right. Of the mammals the monotremes

have a larger left ovary and eggs have been recovered only in the corresponding tube. In young calves Willier (1921) found that two-thirds possessed a larger left ovary with more advanced follicles than the right. Corner (1921) has recently published tables from which it appears that in 139 sows, 616 corpora lutea were in the left ovaries and 504 in the right; in this animal the history of the corpus luteum is known exactly and they represent accurately the number of eggs discharged. For man, Simpson (1906) and others have held that the left side usually has the female type of gonad and hermaphroditic disturbances are generally on the right. On the contrary, Murray (1918) reports 75 observations which show the human corpus luteum 38 times in the right ovary, and 37 in the left.

Corpora lutea are mentioned in 8 individuals of the twin series, 5 times in the homolateral ovary and twice in the opposite ovary. Nine ovaries are recorded as pathological, 3 homolateral and 6 contralateral. Ten (or 11?) ovaries were removed, 6 (or 7?) on the same side and 4 opposite. In 9 cases the opposite tube was excised and the uterus twice. The removal of these adnexa is significant in view of accumulated statistics which show that of all women having ectopic pregnancy only about 33 per cent have a normal uterine gestation later, while about 15 per cent have a repeated ectopic pregnancy in the other tube.

The twin series furnishes 36 adequate menstrual histories. It is of great interest to learn that in 9 cases, or 25 per cent, the embryos are of such size as to indicate there had been one, and in a few cases more than one menstrual period after the pregnancy had begun.

10. *The symptoms of tubal twin pregnancy.* The symptoms are qualitatively identical with the classic picture of ordinary tubal gestation. Quantitatively the time of rupture seems on the average to be retarded—from the data available, at the end of the tenth week (see preceding page). Actually the condition has never yet been diagnosed before operation; in the older cases it might be done by X-ray.

11. *The cause of tubal pregnancy.* Possible predisposing or causative factors of tubal implantation are mentioned in only a few instances in the twin series; for example, two had suffered from puerperal fever, two with peritonitis and one oophoritis. However, Mall (1915) has shown satisfactorily that any change which delays the ovum in its progress will favor tubal pregnancy and that the commonest factor so operating is inflammation of the tube (see *the sterile period*).[1]

12. *The cause of tubal twinning.* The tendency to produce double ovum "twins," which really are not twins at all, is often hereditary. The present twin series offers one illustrative case (Saniter, 1905) in which both grandmother and sister had also borne twins.

Single ovum twinning, on the contrary, is not directly heritable but is the result of immediate environmental influence on the course of development. Thus, Child's (1907) monochorial specimen is from a mother of six children, the last twins 5 years before; here the data is meager and does not imply heredity but rather a common cause in both instances. Lucas-Championnière's (1903) case is one of single ovum twins after 10 years of sterility; there were no twins in either the father's or mother's family. In McCann's (1906) case the twins came 11 years after the last birth and were monochorial; the patient's mother had had fourteen children, but there was no family history of twins. Stockard (1921) has reduced the causal terms of single ovum twinning, and all non-hereditary malformations as well, to the common basis of properly timed developmental arrests. This principle may be applied to human twinning (Arey, 1923 b). The same conditions that induce or accompany tubal implantation also appear to favor twinning, for tubal twins are about fifteen times more common than the uterine ratio (Arey, 1922 b).

13. *Superfetation.* Although superfetation is doubtless exceedingly rare and most cases may be justly criticized as spurious, it is absurd to deny its contingency even if proof is difficult. Admitting the possibility of ovulation after pregnancy has begun, there can in any event be no argument against successive bilateral tubal twins or a tubal gestation combined with a later uterine pregnancy. When

there exist two unequal embryos with separate sacs, or unequal chorionic vesicles the larger of which contains an embryo and the other merely degenerating villi, or separate tubal enlargements containing villi only, it is necessary to consider them at best as doubtful twin specimens, e.g., Handley (1906); Fenger (1891); Johnson (1894); if the history is strongly corroborative they become probable, or presumptive cases, e.g., Saniter (1905), Schauta (1905), Ferroni (1903). On the contrary, markedly unequal fetuses may be satisfactorily accepted as twins under exceptional circumstances. An example is Folet's (1896) case in which a single chorionic sac contained a full term and a 3 months' fetus both connected to the same placenta. Another illustration is furnished by Rupin (1860) wherein a 6 months' fetus and the bones of a 4 months' fetus were found within a common sac; the history supports definitely the twin interpretation. On the contrary, the histories of certain other spurious cases point to the fusion or incorporation of an older by a younger specimen (Henricius and Kolster, 1899; Racoviceanu and Bogdanovici, 1904).

SUMMARY

Tubal pregnancy (single and twin) tends to occur in women who are older by four and one-half years (31.0 years) than the average age for motherhood (26.5 years). These women fall into two groups: (1) Three-fourths are already mothers (but without recent pregnancies) and nearly one-half are multipara; previous abortions are common. (2) One-fourth have been married a relatively long period without becoming pregnant. The sterile period since marriage or the last pregnancy averages nearly 6 years.

The best data available indicate that rupture occurs in 58 per cent of all cases of single tubal pregnancy. The greatest frequency of rupture, and hence peril to the mother, is in tubes with normal embryos (70 per cent rupture), less in those with pathological embryos (50 per cent rupture), and least in tubes which contain degenerating ova without embryos (40 per cent rupture).

Eighty per cent of the recorded specimens of monochorial tubal twins had ruptured, but this figure is surely too high, because unruptured specimens with degenerated embryos of necessity remain unrecognized. There is nothing to indicate that monochorial twins by their bulk alone induce more certain rupture.

The average time of rupture in single tubal pregnancy is at 7.7 weeks. The corresponding figure for tubal twin pregnancy is 10.9 weeks. It is probable that the unusual feature of twinning leads to a more representative collection of the older specimens than in single gestations; hence the later date in the twin group is not really significant.

The average age of normal, single, tubal embryos at the time of operation is 8.0 weeks. In the tubal series the mean age of the monochorial specimens is 11.6 weeks.

Tubal embryos that cease development may remain unresorbed for long periods. On the contrary most disappear rapidly, first the embryo, then its sac. For this reason tubes that are still small at the usual time of operation contain at best pathological embryos. It is only in small tubes with early histories that the most desirable young stages will eventually be found.

One-fourth of the tubal twin specimens have histories that indicate that at least one menstrual period occurred after pregnancy began.

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AUTOTRANSFUSION[1]

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MR. I. B., age, 51; occupation, farmer. The family history is negative. Patient is the father of three children. His wife has had no miscarriages. Patient had the usual diseases of childhood. In 1917 he had three chills in 24 hours. His physician diagnosed them as coming from the kidneys. In 1921, he had the influenza, which was followed by a vesicular eruption limited to the upper left half of the body. He denies venereal disease, his habits have been regular, and digestion has been good. He has had frequency of urination for the last 3 months.

Sixteen years ago patient was seized with an attack of bloody vomiting. Following this he noticed the appearance of a lump in the left side. Five years later he was seized with an attack of vomiting and, as he expressed it, passed blood and corruption both ways. The tumor became immediately smaller but in a short while took on a rapid growth and attained two-thirds of its present size. He has had a similar attack about once each year, followed by pain and tenderness over the tumor and confining him to his bed for several days. In the intervals he has done hard manual labor. The tumor caused him little inconvenience except when he leaned over. For the last 2 years he has been gradually growing weaker, and for the past 2 months he has been unable to work. The tumor has increased noticeably in size and he has swelling of the feet and ankles for the first time. He is 40 pounds underweight.

The interesting points on physical examination were the protuberant abdomen, marked anæmia, emaciation and expression of anxiety reminding one of the facies ovarica. There were no enlarged glands. The heart was pushed up. A blowing murmur, systolic in character, was heard over the whole præcordia. The mass in the abdomen was outlined as follows: Level with nipple—left axillary line passes downward under xiphoid process, crosses the median line to a point 2¾ inches to the right and on a level with umbilicus, then it passes downward and to left crossing median line 2 inches below navel and goes across to crest of left ilium and upward, filling in the flank and back to the point where it started. The mass is hard and a distinct notch can easily be made out. It moves up and down with respiration and can be pushed over to right side 1½ inches from its normal position and is dull to percussion. Urine is negative except for a few hyaline and granular casts. The blood shows the usual picture of severe secondary anæmia, hæmoglobin of 35 per cent. Coagulation-time, 3 minutes. Wassermann, negative. Malaria, negative.

X-ray shows large mass in upper left abdomen xtending downward and to right. Kidney shadow is normal. The blood pressure is 128—88. Pre-operative diagnosis: splenic anæmia.

Patient entered hospital August 18, 1922, and 750 cubic centimeters of citrated blood was given to patient with rise in the hæmoglobin to 55 and a corresponding rise of the other elements. Two days after the transfusion the patient was taken to the operating room and the abdomen opened along the whole length of the left rectus muscle. There was a small amount of free fluid in the abdomen, and the spleen was found to be densely adherent to all the surrounding viscera as well as to the parietes of the left side and diaphragm. These adhesions were very vascular. The spleen was first detached from the diaphragm and the sides of the left abdominal wall, and hot packs were immediately placed in these locations. The other adhesions were then carefully tied and cut, the pedicle was doubly ligated and the spleen removed. The operation was not only difficult but bloody. The patient's pulse was 72 at the beginning of the operation; at the time the spleen was removed it was 140. The large amount of blood that was lost in the abdomen during the operation was recovered by means of expressing the contents of the abdominal packs into a glass receptacle. A little over 800 cubic centmeters, of blood was recovered, and after this was citrated and strained it was injected into a vein at the elbow. The management of the blood and the transfusion was carried out by Dr. R. C. Derivaux, and by the time I had covered over the raw surfaces and closed the abdomen he had almost completed the transfusion. At the time the transfusion was started the pulse was 140 and barely perceptible; at its completion, pulse 102, strong and patient's color good. There was no reaction following the transfusion. Operative recovery was unusually smooth and at the end of 2 weeks he was able to leave the hospital and return to his home. The spleen weighed 7½ pounds and its measurements were 14 by 8 by 4 inches. The postoperative diagnosis was splenic anæmia, which was confirmed by the pathological report.

The full details of this case have been reported for the reason that it impressed me as an ideal case for autotransfusion. I have used this procedure in 3 other cases successfully: 2 of ruptured tubal pregnancy, the third a nephrectomy. I suggested autotransfusion in a discussion of a paper on "Ovarian Apoplexy" at the Chattanooga meeting of the Tennessee State Medical Society, in 1919. At that time I was under

[1] Read before Southern Surgical Association, Memphis, Tennessee, December 12, 1922.

the delusion that I was bringing out something new, but a search of the literature showed me that the Germans had been using this procedure since 1914. The abstracting and search of the literature was carried out for me by the Research Department of the American College of Surgeons. Numerous articles of unusual merit and scientific interest are included.

LITERATURE

Autotransfusion was first used by J. Thies in 1914. Since then 164 cases have been reported in European literature covered in this review. Following operation fourteen deaths were reported: one resulted from a technical error, one from hæmoglobinuria, the remaining 12 were from postoperative complications or concurrent injuries. The method has been most frequently used in Germany. Only 4 of the 164 cases were reported from outside of that country. The type of case was most frequently ectopic gestation, rupture of the spleen or liver, and hæmothorax. In only 6 cases was there a postoperative reaction. In cases of large hæmorrhage in an infected field, A. Shafer has collected the blood and used it as a rectal enema with very favorable results. It has also been given subcutaneously and intramuscularly. Zapelloni and Biser have used gauze to remove the blood. The other authors have employed vessels of various description. It has been frequently commented on by many authors that blood in the pleura or peritoneum coagulates very slowly and may be used after a considerable time. Some authors seem to think that re-infusion has some hæmatopoietic action. The operation has been used by twenty-eight European surgeons. Only one (Opitz) advises against it.

Von Arnim (1) reports that the University of Kiel has employed re-infusion in 12 cases of extra-uterine pregnancy out of a series of 135 treated since 1916. Saline solution was used with the blood in the proportion of 2 to 3. Re-infused patients recovered more rapidly than many patients in whom bleeding was not profuse. Of the 12 cases, 1 died because of an obvious blunder in technique and diagnosis.

Blechschmidt (2) reports 4 cases of ruptured tubal pregnancy with no mortality. An addendum to the thesis states that in the meantime 2 cases had been treated at the Zwickau Hospital following rupture of the spleen in which autotransfusion had been combined with extirpation. In 3 cases the loss of blood was more than 3 per cent of the weight of the body, so that a saline solution probably would not have sufficed. A review of the material shows that the re-infusion of even small amounts of the patient's own blood is beneficial.

Bumm (3) reports 13 cases of auto-reinfusion in extra-uterine pregnancy with 1 death (patient was practically moribund at the time of operation). In 2 cases rigor and fever followed the infusion immediately. Bumm is of the opinion that the patient's own blood is superior to that of any donor.

Burchhardt and Landois (4 and 5) report one case in which death occurred as a result of a shrapnel wound of the spinal cord. The patient was temporarily much improved by re-infusion.

Burchhardt (5) states that Thies originated the method of auto-reinfusion that Lichtenstein used 1 year later. Thies was unable to report a large number of cases because of his work in the field.

Doederlein (6) reports 5 cases of auto-infusion with 1 death due to septicæmia which had no relation to the autotransfusion. He says that experiences show that autotransfusion is a harmless and life-saving procedure.

Eberle (7) reports 8 cases of autotransfusion in ruptured tubal pregnancy with 1 death. The immediate effect of transfusion in the fatal case was good. In 4 traumatic cases all died. All were in a serious condition when transfusion was done. Good effects followed the infusion in 2 cases. The author in conclusion says the problem of blood transfusion is by no means completely solved. Much is theoretical. Blood physiology, experimental surgery, and hospital practice must progress considerably before a final judgment upon the procedure can be given.

Elmendorf (8) reports an interesting case of a soldier, age 25, who was injured in the right thorax by an infantry shot. He collapsed immediately and was carried three hundred paces to the temporary station. After watching the case for 1 hour, an ordinary infusion needle was inserted between the fifth and sixth ribs in the mid-axillary line. By this means 100 cubic centimeters of blood was withdrawn three times in the course of 15 minutes and immediately injected into the arm. The blood was filtered through a compress and no coagulation was noted. Progressive improvement followed. On the eighth day the soldier was removed farther back from the front and on the fourteenth day was transported to a base hospital.

Fieber (9) reports the successful use of auto-reinfusion in a case of rupture in the spleen from a grenade wound.

Henschen (10 and 11) makes a complete review of the literature but adds no case reports. He favors re-infusion to facilitate recovery, even in cases involving only moderate hæmorrhage.

Kreuter (12 and 13) reports the successful use of re-infusion in a case of rupture of the liver. In another case of rupture of the liver, good results were

obtained from transfusion but the patient later died from concurrent injury.

Kulenkampff (14) reports the use of auto-transfusion in 9 cases of ectopic pregnancy and 2 cases of rupture of the spleen.

Landgraf (15) suggests that auto-transfusion be practiced following loss of blood during operations but he had not tried out the suggestion.

Laewen (16) used the method in 3 cases of injury to the liver from war wounds with immediate good results, but the patients later died from concurrent injuries.

Lichtenstein (17, 18 and 19) reports the use of auto-transfusion in 39 cases. There were 25 cases of ruptured ectopic pregnancy with a successful result in all. Six cases were war injuries treated in the field and unfavorable results were reported only in such cases. He brings out a point which is corroborated by a number of others that rather long intervals may elapse before unfitness of the blood for re-infusion need be feared.

Loehnberg (20) reports successful use of the method in 14 cases. The quantity of blood injected varied from 500 to 1150 cubic centimeters. It was maintained at body temperature after defibrination by stirring with a glass rod and was injected without being thinned. He is convinced that no other method can produce equal results.

Opitz (21) reports one case of somnolence, icterus and restlessness, not alarming, following auto-transfusion. He advises against autotransfusion and will return to his old procedure of leaving the blood in the abdominal cavity whence it is absorbed rapidly.

Ostwald (22) reports one successful case of re-infusion following a ruptured ectopic pregnancy. He is of the opinion that in addition to neutralizing the low blood pressure and increasing the amount of fluid in the veins, re-infusion returns to the blood a number of normally active erythrocytes and a serum adapted to the particular organism with reference to protective substances and secretions.

Peiser (23) reports the successful use of auto-reinfusion in rupture of the spleen.

Ranft (24) also reports a successful case in rupture of the spleen from a grenade fragment.

Rietz (25) reports some interesting experimental work on animals.

Roedelius (26 and 27) reports 12 cases of auto-transfusion used in ruptured tubal pregnancy. He states, however, that he believes only 1 of the 12 cases re-infused would have died without this aid.

Schaefer (28, 29, and 30) reports 4 cases of auto-transfusion following obstetrical accidents. In two of these cases blood was expressed from the placenta. In one case, on account of the blood being contaminated, he used it as a rectal infusion.

Thies (31) was the first surgeon to advocate and use autotransfusion. Three cases of extra-uterine pregnancy are reported. All three patients who had been pulseless recovered and were dismissed 7 days after the operation. Before this method was employed the blood in several other cases had been examined bacteriologically. It was always free from bacteria. Microscopically all erythrocytes were intact. No coagulation had occurred. The method is recommended for cases that are pulseless and where the hæmorrhage has occurred recently.

Toepler (32) reports 24 cases of re-infusion in ruptured extra-uterine pregnancy. He quotes Schweitzer who reports one death from hæmoglobinuria.

Wederhake (33) strongly recommends auto-transfusion in gunshot injuries to the lungs. With a hæmothorax the blood was removed by means of puncture, filtered through a sterile cotton wadding, and injected intravenously. It was always possible to dispense with the use of sodium citrate and with defibrination. Experience has shown that the blood of a hæmothorax coagulates with difficulty.

Zapelloni (34) reports a successful case of re-infusion in ruptured ectopic pregnancy.

Two cases are reported in English literature, one by Dr. Ogilvie of Guy's Hospital and one by Sampson of the General Hospital, Birmingham.

The American literature up to the present time shows very little on this subject. The author personally knows of a number of cases, however, that are to be reported soon.

Dr. Francis C. Grant (35) reports a very interesting case from the service of Dr. C. H. Frazier of the University Hospital, Philadelphia. A suboccipital exploration was determined on. It had been their routine practice of late to transfuse post-operatively all cases upon whom a suboccipital exploration had been performed. The patient was large, stout, and plethoric. Five hundred cubic centimeters of blood was withdrawn, kept in 2 per cent sodium citrate solution, in the refrigerator. Twenty-four hours after the withdrawal of the blood, the operation was carried out and the patient's citrated blood was injected into a vein of the arm without reaction. The postoperative course was favorable. Grant suggests in conclusion that although the plethora and high blood pressure seemed special indications in this case, autotransfusion might be considered in other conditions.

Dr. Murray B. Davis (36) reports a case of autotransfusion for gunshot wound of the spleen. The transfusion served an excellent purpose, but unfortunately the patient developed a bronchial pneumonia and died on the ninth day.

Levine and Segall (37) have a very interesting article on "Posttransfusion Reactions." They bring out the point that a long operation in which ether is used as the anæsthetic alters the patient's serum as regards its hæmoagglutinin properties. This change is not a permanent one but disappears during the first 24 hours after operation, i.e., just before the time when the patient has recovered from the effects of the ether anæsthesia. They conclude

as follows: First, the compatibility of the recipient's and donor's blood must be determined prior to each and every transfusion; second, no transfusion must be done during or within 24 hours after prolonged ether anæsthesia, even when the donor has been found suitable previous to the beginning of the anæsthesia.

If these conclusions are correct, and I believe that they are, it makes autotransfusion a most valuable procedure in certain cases.

CONCLUSIONS

Autotransfusion is a safe procedure, although in a limited number of cases reactions will occur.

Sodium citrate is not essential. Normal salt solution will make an admirable substitute and if neither of these is at hand, the pure blood may be re-injected.

Extra-uterine pregnancy will offer the largest field of usefulness for this procedure, but in wounds of the spleen, liver, wounds of the lung producing a hæmothorax, and in operations where a large amount of blood is unavoidably lost, it will not only save life but will hasten postoperative recovery.

Contaminated blood should not be thrown away, but should be given as a rectal drip.

Autotransfusion may occasionally be used to advantage in certain obstetrical complications, such as placenta prævia, rupture of the uterus, and cæsarean section.

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BISMUTH PASTE TUMORS[1]

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SINCE bismuth paste has been used so extensively in this clinic for so many years in the treatment and diagnosis of suppurating conditions about the head and body, and as we have within a short period of time observed a series of four cases which presented themselves with obscure findings following its use, it was deemed advisable to study more carefully the probable cause and character of the pathology of such a tumor formation.

Inasmuch as we find that there is an ever-increasing use of bismuth paste and modified pastes and preparations of bismuth, it is rather interesting to note that there may be a tendency toward an inflammatory growth. The use of bismuth paste, therapeutically and diagnostically,—especially the latter—is considered by many to be of utmost value and more so since the advent of the X-ray. As a diagnostic agent to determine the course of sinuses, to follow them throughout their devious paths and localize definitely the nidus of infection, the injection of bismuth paste and its interpretation by the X-ray is of greatest value. Were there no therapeutic indication of efficacy in its use, the information it reveals about the character and extent of the exploratory procedure required, would be enough in its favor. However, we know of its many advantages, have seen good results from its use and so have many others who go down on record in the literature as having obtained splendid results. There are today, even more indications and values for employing this material. Therefore, we would not have it appear that tumor formation is a frequent occurrence, but report it on the basis of its rarity and perhaps add a few significant points to be remembered and kept in mind in its use.

Bismuth paste has been in use for more than 15 years, having first been presented by Dr. Emil G. Beck and his brothers, in 1906. It has been used continuously since that time by themselves and others, both diagnostically and therapeutically. It is prepared in varying strengths and mixtures, depending upon the indication, but it is not the purpose of this paper to give any detailed report dealing with its preparation other than it concerns points of argument as they arise. We shall, however, refer to the abundant literature on the subject.

Because of the close similarity between paraffinomata, camphorated oil tumors, vaselinomata, and the tumors caused by bismuth paste, common points of interest will be discussed. While these tumors may not be the same, it is interesting to note that the bismuth paste may, and does, more or less involve them all, since it contains not only bismuth subnitrate but also vaseline and paraffin in small amounts. The paste employed in our work contains 10 per cent bismuth subnitrate in vaseline, to which is frequently added small quantities of paraffin and white wax, all of which are mixed together until a homogeneous mixture results. There are three other bismuth paste mixtures which are used, containing larger amounts of the subnitrate of bismuth, all of which must be prepared under the most aseptic precautions. The method of introduction of the paste is by the use of metal or glass syringes, many types of which have been devised to fit the individual indication. The paste is introduced in semiliquid form into the sinuses with moderate amount of force. These injections are repeated, in some instances every day or every other day, depending entirely upon the existing pathology and the response to previous injections.

It is a well-known fact that the injection of paraffin has a tendency to cause the formation of inflammatory growths with the possibility of becoming malignant, and it was on this basis that its use, especially in rhinocosmetic fields, was discouraged. When Gersuny, in 1900, published his article "Subcutane Prothese," the paraffin idea was greeted as a revelation, and his own cases opened up many channels for a possible usefulness of this material as was mentioned and suggested by him. The basis of his experiments was as follows: If melted vaseline is injected into the soft tissues of the human body, the embedded

[1] Studies, reports, and observations from the clinic of Drs. Joseph C. Beck, Harry L. Pollock, and Francis L. Lederer, Chicago. Presented before the Chicago Pathological Society, November 13, 1922.

Figs. 1, 2, 3 and 4.—Showing bismuth paste mass in frontal sinus following a radical frontal sinus operation. Case 1.

mass, after hardening, apparently remains unchanged and stays where it has been deposited. Then followed Corning (1891) who suggested the introduction of solidifying oils into tissues in order to bring about the occlusion of blood vessels. M. Balzer (1886) demonstrated conclusively that vaseline is not absorbed in tissues but persists there in the state of foreign droplets and that this results whether the vaseline is introduced in all pathological processes but especially in tuberculous conditions.

It is commonly agreed that the introduction of such foreign substances as paraffin, vaseline, camphorated oil may produce a traumatic inflammatory reaction which is brought about by tearing, stretching, or forcing apart various tissue fibers, leading eventually to the formation of connective tissue, resulting, as in the case of any foreign body, in an attempted encapsulation of the injected material, assuming, of course, that we are dealing with a sterile agent. The small globuli are broken off from the material by muscle contraction, then travel and stimulate connective-tissue and cell proliferation of the adjoining tissue in their paths. They thus finally grow together like a sponge and are formed into a meshwork.

There are, of course, various factors to be considered in drawing any conclusions as to why such a reaction occurs. It is highly probable that the melting points of the mixtures may be factors. Eckstein says, and by well-carried-out experiments has proved, that mixtures up to 110° F. (this figure probably being the limit) even if injected in semi-solid state, do not retain their pasty consistency in the body. If vaseline, up to a melting point of 105° F., is cooled down in the syringe to a consistency of semi-solid thread, which it attains at a temperature below that of the body, and then is injected, it naturally melts again into a fluid state as soon as it is deposited into tissues having a higher temperature. Even a mixture having a melting point up to 110° F., is at 99° F. just as good fluid. As proof of this, may be cited many cases where vaseline, when introduced into fossæ and tissues, could be recovered many years later, remaining in a perfectly fluid state. Eckstein concluded from his experiments that, different from the vaseline or paraffin of a very low melting point, which, according to Gersuny and others, is permeated by the proliferating connective tissue and subdivided into meshes containing single, shining globuli of small proportions, perhaps is apt to be absorbed: whereas paraffin of a high melting point will never yield to absorption. This, however, is a much disputed point, and many are affirmed in the belief that the melting points are not important factors.

Hertel, in the work of replacing orbital defects, did excellent work in many series of cases and his deductions are quite interesting. He believes that differing results lie with the differing distribution of the paraffin with regard to the tissues and refers to the work of Leber, who proved that the irritative effects of foreign bodies upon tissues are augmented if they are finely divided, and that the larger

the surface they come in contact with, the more intensive the irritative effects. Hertel also emphasizes that there may exist still another important factor and that is that all preparations of vaseline, paraffin, etc., may not have the same chemical composition, and was of the opinion that the new-growth of connective tissue ultimately leads to the reabsorption of the material, and the harder the paraffin, the more protracted the process.

However, it is a mooted question as to what ultimately happens to the bismuth vaseline preparation. Dr. J. C. Beck introduced the paste into various sinuses, such as the frontals, sphenoids, and antrum, and studied radiographically the length of time the bismuth remains in these cavities, but came to no definite conclusions. Dr. E. G. Beck contends that most of it is found in the dressings within 24 hours after injection; in other sinuses, which are deep and tortuous, the paste will remain in them for days and even weeks, and says that frequently it will heal in and become encapsulated and gradually be absorbed through the process of organization of the mass by connective tissue. The latter author also checked up the reaction of living tissues to bismuth paste, and this same process was found to go on. His microscopical studies showed the border of the bismuth crystals infiltrated with round cells and the spaces between the crystals packed with young connective tissue cells. The border between the bismuth mass and the muscle tissue removed, consisted of several strata of elongated connective tissue cells forming concentric layers and in some places, merging into fibrous bands encircling the bismuth plug. There was also seen a large number of irregularly arranged, shorter and longer, spindle shaped cells, which in places invaded the interstices of the adjacent muscular tissue. Whatever the histological findings might have been, Beck thought that radiographic evidence was proof enough that bismuth was absorbed and gave as example lung abscess cavities, which were shown in various stages as time progressed and the lung expanded, with a diminution of their radio-obstructive contents. Just what happens to this material is not the object of this paper because Beck and others long ago considered this phase of the subject in connection with bismuth poisoning and found that bismuth, when absorbed, may be found in the cells of the liver, spleen, muscles, and intestines.

Fig. 5. Roentgenogram showing bismuth mass in frontal sinus. (Case 1.)

This paper deals mainly with the local manifestations resulting from the use of these materials. Experience with vaseline and various other mineral oil preparations has demonstrated time and time again their resistance to absorption. Moschiewitz, Gersuny's assistant, was detailed to study the question thoroughly and one of his most important conclusions was that if injected vaseline is left undisturbed for a time and protected from muscular contraction or pressure from without, it becomes firmly encapsulated and should be well able to withstand absorption. It is in this connection that camphor oil tumors deserve mention and especially the work of M. Letule in collaboration with M. Alglave on pseudo-tumors provoked by the injection of medicated vaseline into the tissues. They report many cases of such tumors which were studied clinically and histologically in vary-

Figs. 6 to 9.—Tumor mass in mid line of neck and mass removed at operation. (Case 2.)

ing stages, as their cases were of long and short duration. One case was of 16 years' standing in a woman who had received several injections of camphor in oil into the breasts. There resulted ten or twelve masses varying in size up to that of a walnut and seeming in some way or other to be connected with one another. They were located just under the skin and seemed to be adherent to it, being smooth and in some places appeared so congested as to resemble early abscess formation. Having had experience with such tumors they recognized them immediately. The patient in subsequent child-births could not nurse her infants because of interference by these masses with lactation. The tumors were only slightly painful and this did not occur until 11 years after the initial injection. Operation was advised but was not as cosmetic as originally planned due to the ramification of the masses into the pectoral muscle and adjacent tissues. These masses were fibrous, especially toward the center of the original injection and softened out toward the periphery. They cut with a firm resistance. Grossly they resembled masses of fibrous and adipose tissue. The authors then concluded that camphorated oil should be avoided because of its slow absorption but progressive and uninterrupted tendency toward tumor formation.

Fig. 10.—Roentgenogram showing bismuth mass in neck. (Case 2.)

Case 1. A. S., male, age 25. In November, 1921, patient had a mild influenza which became complicated by a pansinusitis and accompanied by meningeal symptoms. He went along for 2 weeks with marked toxic symptoms, when at this time a fluctuating mass was found to be necrotic in an area about the size of a dollar. He was referred to us on December 1, 1922, still complaining of frontal pain. The X-ray at this time revealed a bone necrosis in the frontal region with the posterior table apparently intact. Operation was advised and under synergistic analgesia, a radical frontal sinus exploration was done. The periosteum over the frontalis was found greatly thickened, being about one-fourth inch thick. Granulations were forming on its posterior surface. The interior table over

Figs. 11 to 14. Healing after removal with tendency toward keloid formation; after radium application to keloid and final result.

both sinuses was found to be necrotic and a horse-shoe-shaped sequestra was removed. Both sinuses were quite large and were filled with granulations and thick, desicated pus. The mucous membrane lining of the sinus had undergone polypoid degeneration and polyps were found blocking the nasofrontal ducts. Drainage was established into the nose and the wound closed by interrupted sutures. He was redressed daily; temperature remained normal and on the fourth day, a colloidion dressing was applied. Except for swelling of both upper lids patient made an uneventful recovery. On December 31, 1921, bismuth paste (10 per cent) was injected into both frontal sinuses and patient was allowed to go to his home. On May 28 patient returned having had an uninterrupted course, except for a swelling over the frontal sinus which did not bother him and was not tender. The nasal examination was negative; externally was seen a small tumor-like mass about the size of a half dollar. No fluctuation nor tenderness was elicited and the tumor was hard and not very well defined, being infiltrated into skin and adjacent tissue. X-ray examination revealed a bismuth mass in frontal sinus.

Case 2. C. R., male, age 15, Italian. About 2 weeks before, while at work patient noticed neck was getting stiff. He went home and went to bed complaining of a general malaise. The next morning when he awoke he noticed his neck was badly swollen and slightly tender. He went to his family physician who tried palliative measures, but the swelling and fluctuation became so severe that he incised the left side of the neck in two places above the sternocleidomastoid muscle. About this time patient was referred to us. He was quite toxic and had a leucocytosis of 16,000; the blood culture was returned negative and the pus showed a pure culture of staphylococcus aureus. Examination of the nose revealed an extreme amount of crusting and atrophy; teeth, showed poor hygiene but were in fair condition; tonsils definitely pathological and injected, pus being easily expressed from them. The areas in the neck were still draining but the patient's condition was very poor. Palliative and general tone methods were carried out. About 2 weeks later after the acute symptoms had subsided bismuth paste (10 per cent mixture) was injected into the draining sinuses. It was noticed at this time that these sinuses communicated with an area suprasternally, but this was thought only to be a communicating sinus. He was injected with bismuth on two successive days and then began to get a series of X-ray treatments to the side of his neck. The patient was discharged with sinuses healed 3 weeks from the time he was referred to us. About 1 month later patient returned with an enlargement in the mid-line of his neck just above the sternum. It was hard, very slightly tender and seemed to be infiltrating the skin and adjacent tissues for quite an area around it. It was not well defined. X-ray revealed the masses to be made up of bismuth. Patient was advised to do nothing. Then on July 19, under synergistic analgesia the tumor was excised. The mass was found to be adherent to the skin and to the substance of the sternohyoid and sternothyroid muscles. When removed it measured 2 inches in its greatest width and 3½ inches in length. It had a very hard, almost cartilaginous feel and cut with the resistance of dense, fibrous tissue. The cut surface disclosed innumerable pockets of varying shapes and sizes, the largest being about one-fourth inch in diameter, which were surrounded by dense, fibrous tissues. These pockets contained a thick, creamy, yellowish substance. Culture of this material and that taken from other places showed no growth after 48 hours. The smear revealed no organism but many crystal-like bodies. This wound healed uneventfully. About one month later there was found a very dense infiltration along the same place as where the bismuth mass was located. This had neither the consistency nor appearance of the former mass but was keloid in character. On this basis radium 103½ milligrams for 3 hours (310 milligram hours) was placed on the area. There

was only a slight local reaction following this radium application and the keloid disappeared. X-rays taken since still show small bismuth plugs which could not very well be removed at operation but are evidently deeply seated.

Case 3. Sus., male, age 14. This case is in practically all respects similar to Case 2 so that repetition will not be necessary except to say that in this instance the mass formed at the site of injection on the right side of the neck. The mass was markedly adherent to the skin, not tender and had been present for 3 months. It was also excised and findings were of similar nature. It is interesting to note that this boy's brother had some such similar swelling following bismuth injection, but there is no confirmation of this other than clinically.

Case 4. Mrs. J. B., complained of tearing and pus discharge in left eye for past year. After probing the lacrimal duct it was found to be stenotic. Patient was advised to have operation and so under synergistic analgesia the usual incision was made and the lacrimal duct was exposed. The canaliculus had previously been injected with a 10 per cent mixture of bismuth paste and found to be blocked about the region where it opens into the sac. The duct was then opened and the bismuth was found under tension. A small window was made into the sac and a passage made through the natural opening into the nose. This opening was enlarged by means of an electric burr and a catheter introduced into the groove and passing down into the nose just below the anterior end of the middle turbinate. The periosteum was sutured over the end of the tube which was brought up into the canaliculus. The external wound was then closed completely. The catheter was allowed to remain in for 4 days. Almost 3 weeks later the duct was injected with bismuth paste and was found to be patent, the paste coming out through the nose. Symptoms which she had formerly subsided for a time only to re-occur again when the duct closed. About one month later at the site of the old incision there formed a hard infiltrating mass which was not tender and not easily movable. This was thought to be due to the bismuth, and X-ray confirmed the diagnosis. Operation was advised and so under synergistic analgesia the old scar was resected. It was found to be infiltrated by bismuth as was much of the adjacent tissue and that below it, including the anterior wall of the sac, therefore necessitating removal of the sac in small pieces. Bismuth paste was easily expressed from the meshes of this tissue. The opening into the nose was enlarged, the wound packed from within the nose, and the external wound closed completely. Healing was ideal. While the patient has still some tearing there is no more pus and no scarring resulted.

HISTOPATHOLOGY

The microscopic sections of these tumor masses show a recent, not very vascular, connective tissue in different stages of development. This connective tissue is of varying age, some dense tissue, hyaline in character, and some looser, consisting largely of fibroblasts and oval cells. Blood vessels are but few in number and show nothing particularly characteristic. There are a great many spaces of different sizes up to a centimeter or more in diameter, irregularly distributed throughout the tissue, and in some areas they are so numerous as to give a honeycombed appearance. Most of the spaces appear empty, others contain bismuth granules or masses. In shape, the majority of the spaces are round or oval, the others being more or less irregular. The borders of some of the larger and irregularly shaped and slit-like spaces contain dense masses of bismuth granules between and within the young connective-tissue cells, while the smaller spaces, especially the round and oval, may be lined with a rather narrow rim of multinucleated cytoplasmic bands, resembling syncytium. Between the spaces, in the more cellular parts of the tissue, are larger and smaller multinucleated giant cells of the foreign body type, in some of which, as well as in the adjacent smaller cells may be fine bismuth granules.

The giant cells are most numerous in the region of the bismuth masses. Some are small, containing 3 to 5 oval nuclei irregularly arranged, others are larger with 10 or more nuclei. Occasionally a giant cell presents a small bismuth mass with its cytoplasm. Many of the spindle-shaped cells or fibroblasts, reveal fine and coarse bismuth granules within their cytoplasm. Some of these phagocytic cells are more oval in shape and may possibly be endothelial in origin.

A few scattered areas of round-cell infiltration occur among the hyperplastic connective tissue. The cells are chiefly small lymphocytes together with a moderate number of plasma cells.

The appearance of the tissue in general is that of a granuloma, due to the irritation of a foreign body with the resulting connective-tissue proliferation and giant-cell formation.

GENERAL CLINICAL PICTURE

Aside from the variance in time or period of activity, our series shows four patients who

Figs. 15 to 18. Cases 3 and 4. Patient with bismuth paste tumor in lacrimal sac and result after removal. Mass removed from neck.

developed bismuth paste tumors in different parts of the body. It is not a question of the extreme rarity of these tumors in cases where bismuth paste has been used, and these are many, but the fact is that they have occurred and have presented some interesting clinical features. All had practically these features in common following the injection of bismuth paste for a previous illness: tumor masses appeared within a range of 1 to 6 months; they have concrete-like infiltrations and vary in size depending on the site, the amount of material introduced and the amount of individual reaction. They are not well defined nor rounded in outline but are irregular and branch-like, there being bead-like infiltrates and ramifications in varying directions, appearing to follow out definite channels, perhaps the lymphatics. This sort of distribution is not to be wondered at when we consider that the paste is introduced with some degree of force and thereby is deposited between the connective tissue and lymph spaces, remaining there as an inert foreign body. The early discomfort is usually very slight and the tumors may not be painful or tender. Locally the skin may show some evidence of an inflammatory process, especially when of long duration, by assuming various hues of congestion. In the mass itself the localized pressure which the foreign body necessarily exerts stimulates, at least temporarily, a low-grade inflammatory process with subsequent gradual production of new connective and fibrous tissue, encapsulating the various particles. In two of the cases there was a tendency toward a breaking-down process with abscess formation. These four cases all presented conditions of chronic inflammation, superimposed on acute exacerbations and these therefore present an interesting anology in this respect.

Diagnostically, each one of these cases presented a very interesting problem in differentiating them from other neoplasms which may occur in these various regions. The bismuth mass in the frontal sinus is extremely interesting because this condition must be considered in the differential diagnosis of a very interesting group of tumors, which are seen radiographically in this region. The same holds true for the other cases, and adds the X-ray as a possible point in differentiating tumors about these parts, when there is a history of the use of bismuth paste.

Therapeutically it may be said that there is only one procedure of choice in dealing with these growths, and that is complete extirpation, at least as much of the tumor mass being removed as possible, without too great a mutilating effect. Palliative treatment in the way of hot applications, etc., seem to have a tendency to produce a breaking down of the tumor and therefore is advisable.

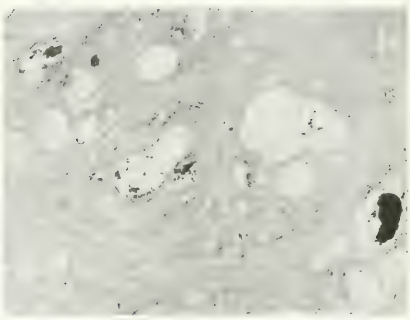

Fig. 19. Low-power photomicrograph showing a recent not very vascular, connective-tissue tumor, containing many spaces of different shapes and sizes irregularly arranged containing bismuth masses and granules.

If total extirpation leads to a tendency toward keloid formation and further infiltration of the tissues, radium applied locally to these definite areas seems to be of great benefit.

What then is the cause of these tumor activities? Vaseline injection alone and various mineral oil preparations have been condemned as dangerous, and warning given to avoid them because of their tendency to produce inflammatory tumors. It is certain that there may be something to this statement and that bismuth paste with its vaseline content is no exception to the rule; but that here too precautions must be exercised in its use. Bismuth subnitrate in itself has been shown not to cause any inflammatory growth, so that it is highly probable that even the reaction obtained in normal healthy tissues by experimentation is one that is due entirely to the presence of the vaseline in the mixture. One may say that as long as the compensatory circulation is present in or about these encapsulated masses that are known to occur, no trouble results; but that after a period of time there is a circulatory unbalance and venous stasis ensues, with the clinical pictures of varying degrees of inflammatory reaction, congestion, all depending perhaps on the amount of pressure exerted by the presence of these fibromata with the encapsulated paste.

As to what accounts for this sudden discovery of a bismuth paste tumor after observation of thousands of cases and without ever having seen any similar reaction, it is difficult to say. However, such inflammatory processes had never presented themselves as clinical cases for differential diagnosis, and therefore, it is highly probable that many similar cases have or do exist without our knowledge. Had not these patients come with such gross external deformities, all being very superficial tumors, they would possibly not have come to our notice. After the use of the bismuth preparation in many somewhat similar cases, it became problematical as to just why these cases in particular should have formed inflammatory growths. It is our opinion just as camphorated oil tumors form by subcutaneous injections, so do bismuth paste tumors form when they come in contact with overlying skin. Other factors which may play a rôle as we see it, are those of chronic infections, which seem to make the tissues more prone for further inflammatory irritations by the foreign substance introduced. We would, therefore, venture our opinion that when the material is introduced into bony wall cavities, taking for granted that there is no outlet, this substance is held inert in this cavity such as the sinus, and while it may infiltrate into the mucous membrane lining, it cannot go any farther because of the obstruction by the bony wall. With this, therefore, in mind it is not difficult to understand that in a case of the frontal sinus tumor which we report, it could have been possible because the entire frontal plate of the sinus had been taken away through the disease and the operative procedure. The principle of the formation of the other tumor masses is the same as that which has been discussed throughout the course of this paper.

It is really difficult to say just what future procedures should consist of in preventing such difficulties. We would not be so drastic as to say that the use of the substance should be discontinued because of the sudden appearance of these few cases. However, it must be kept in mind that there are possibilities through misuse of the preparation or not the proper understanding of its action, as a factor

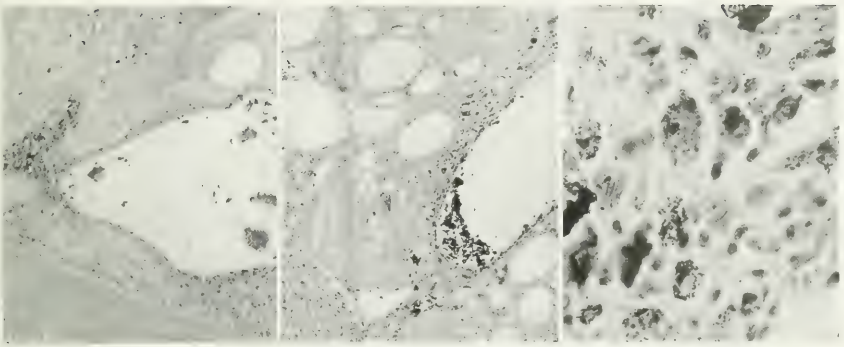

Fig. 20. Fig. 21 Fig. 22

Fig. 20. Low power photomicrograph showing that the borders of these spaces contain dense masses of bismuth granules between and within the young connective-tissue cells. The smaller and more oval spaces are lined with a rather narrow rim of multinucleated cytoplasmic bands resembling syncytium.

Fig. 21. Low power photomicrograph showing that there are a few scattered areas of round-cell infiltration among the hyperplastic connective tissue. The cells are chiefly small lymphocytes together with a moderate number of plasma cells.

Fig. 22. High power (×7000) photomicrograph showing the foreign body giant cells most numerous in the region of the bismuth masses. Some are small, containing 3 to 5 oval nuclei irregularly arranged, others are larger and contain 10 or more nuclei. Some of the giant cells as well as the endothelial-like cells are seen to have a phagocytic tendency.

in the formation of inflammatory growths. We would submit the following factors and precautions to be exercised in the discriminate use of bismuth paste:

The force with which it is introduced should be minimized.

It should not be used in superficial structures like the tear duct and sac, especially in the presence of chronic infection and blockage.

It should not be used in tuberculous processes, when located quite near the surface in the soft tissues of the body.

It should not be used in sinuses in which the walls are not intact; and,

It should not be used particularly in parts of the body where there is a large amount of muscular activity.

The phagocytosis with the production of the giant cells which occurs in paraffinomata and vaselinomata occurs here and represents nature's response in their effort to restore a much disturbed circulation. The clinical picture as well as the histological one is strikingly like that of paraffinomata and camphor oil tumors. Time enough has not elapsed fully to determine as to whether there is or is not a tendency toward malignant formation. However, as was stated before there has been noted a slight tendency toward keloid formation.

Author's Note—The author wishes to thank Drs. Ludwig Hektoen and I. Pilot for their kind aid in the histological study of these tumors.

Since the presentation of this subject five such cases of tumor formation have been observed and further study is contemplated.

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Fig. 8.—Showing additional layer of haemostats applied in tier arrangement horizontally, tissue being cut away as section of gland advances. Method of grasping gland so that index finger presses on the isthmus, counter-pressure being made by the thumb and bleeding controlled.

DEPARTMENT OF TECHNIQUE

A TECHNIQUE OF THYROIDECTOMY

BY FRANK H. LAHEY, M.D., F.A.C.S., BOSTON

IN the course of thirteen hundred thyroid operations it is but natural that the operative plan should have been modified several times in the endeavor to simplify and shorten the operation, to make more certain the security of those structures exposed to danger, and to diminish the postoperative emergencies and complications.

While we feel that the few special instruments which we have devised to make some of the steps of the operation safer and more precise and possibly one or two steps in the procedure may be original, we make no claim to originality, since everyone must realize that most operative procedures are original only at their conception and approach full development as they are polished by repeated use and their minor defects demonstrated and overcome by the development of satisfactory measures.

We are led, therefore, to present the following technical development of thyroidectomy as used in our clinic at the New England Deaconess Hospital, because it has been employed in the last six to seven hundred operations with much greater satisfaction than the previously employed technique, with relatively few operative and postoperative complications and because it appears to us a logical plan for the rapid removal of a large amount of thyroid tissue, insuring the leaving of a definitely planned amount of thyroid tissue and protecting the recurrent laryngeal nerve and parathyroid glands to the greatest possible degree.

We employ a Kocher transverse incision with a curve just sufficient to correspond to the slight curve made by a fairly closely fitting string of beads, and have found it a distinct advantage not to make the complete transverse incision, but to carry it only about one-half way through the skin except in the exact center of the incision where it is carried down through skin fat and platysma to the prethyroid muscles. As is shown in Figure 1, blunt scissors then separate the platysma from the underlying structures as far out as the ends of the incision on either side. By means of the same scissors the skin, subcutaneous fat and platysma are cut at one time along the original incision, the latter serving to direct the line of cutting.

Fig. 1. Showing incision made through skin but not to subcutaneous fat. Platysma raised by blunt scissors without damage to the large veins on anterior muscles of neck. In most of the cases incision penetrates only half way through skin and does not show subcutaneous fat as shown in illustration.

Fig. 2. Showing dissection and retraction of sternomastoid muscles from anterior thyroid muscles and clamping of prethyroid muscles, sternohyoid, and sternothyroid which are shown separately.

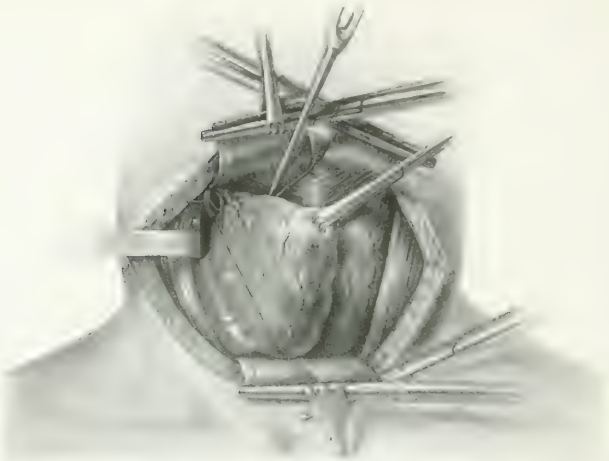

Fig. 3. Showing exposure of superior pole by retraction of internal jugular and common carotid (marked *X*) by special retractor. Spiral ligature passer shown passed around pole. Special double hook. Dotted line shown on gland to represent level at which hæmostats are applied, that part of gland posterior (showing one parathyroid) being preserved and the part anterior being removed.

By means of the above described procedure the incision is kept in its proper line, and considerable time is saved, inasmuch as the large veins running longitudinally on the sternohyoid are not cut, thus preventing much of the troublesome bleeding which occurs when the incision is carried straight through the skin and platysma to the underlying muscles.

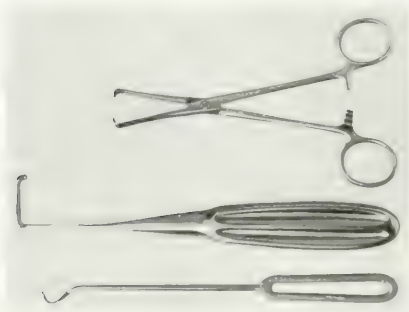

Fig. 4. Special double hook so constructed that when teeth enter gland, shanks compress gland and prevent bleeding.

Fig. 5. Special retractor of correct shape and depth for holding and retracting internal jugular and common carotid.

Fig. 6. Special spiral passer. There are holes for ligature both at tip and at neck of passer, producing bow string effect and facilitating grasping of ligature in deep hole.

The skin flap having been turned up in the usual way, we have next found it of value to dissect free the sternomastoids along their anterior edges, and by blunt dissection free the muscle from the underlying sternohyoid, sternothyroid, and omohyoid muscles. By means of this procedure it is possible to clamp the prethyroid muscles well out under the belly of the sternomastoid, to protect that muscle against incision, and to avoid the danger of catching the internal jugular vein in the tips of the clamps placed transversely across the muscles, as shown in Figure 2.

The muscles having been cut and retracted upward and downward respectively, we have found exposure, ligature, and severing of the superior pole the step which in our hands has made complete mobilization of the gland easy, its only attachment being then at the point of the branching of the inferior thyroid artery and at the place where the gland attaches itself to, and crosses, the trachea.

Ligation of the superior thyroid poles in our hands, either through the small transverse in-

Fig. 7. Showing superior pole ligated and cut, small segment of gland being left (less than shown in the illustration). Double hooks applied and gland inverted. Posterior surface presenting hæmostats applied along dotted line shown in Figure 3, points being plunged into the gland.

cision as the preliminary measure, or as part of the subtotal thyroidectomy, has gradually developed into a procedure so planned that there can be no question but that the ligature surrounds the entire pole and includes vein, artery, and the branches of the sympathetic nerve supplying the gland, this being accomplished by passing the ligature under direct vision with the entire superior pole exposed.

If it be admitted as true that the superior pole of the thyroid with its entering vessels is frequently, if not usually, in close contact with the internal jugular vein and the common carotid artery, and that such is the case will be attested by all who deal frequently with the dissection of these structures in the living, then it becomes evident that separation of the internal jugular and common carotid from the pole and retraction outward must be the first step to insure the complete surrounding of the pole by a ligature. It is clear that otherwise a ligature which would be certain of surrounding the pole would of necessity be in danger of injuring the internal jugular and common carotid so frequently lying against it.

Our plan, then, in ligation of the pole, as shown in Figure 3, is to deliver the superior pole of the gland by means of a special double hook (Fig. 4) having jaws so arranged that after the hooks enter the gland the shanks of the forceps compress the gland and prevent it from bleeding. The pole having been delivered, the internal jugular vein and common carotid artery, exposed at the same level as the superior pole, are separated from that structure and retracted outward by means of a special retractor (Fig. 5), the blade of which we have made of sufficient depth to catch and hold both large vessels without protruding into the wound so that it interferes with the passage of the ligature. If now a pair of small blunt scissors be passed down on the inner side between the inside of the pole and the trachea it is at once clear that the entire superior pole is visualized and a ligature may be passed around it by means of a special spiral shaped passer (Fig. 6), the point of the passer being entered on the inner side where the blunt scissors separated the pole from the trachea, the spiral shape of the passer carrying it naturally around the pole until it emerges on the outer side where retraction of the large vessels prevents injury to those structures and permits clear vision of the encircling passer. The ligature is withdrawn by the manœuvre shown in Figure 3 and the pole tied firmly, care being taken to relax traction on the pole to permit snugging of the knot. For a long time we employed light braided silk, as we wished a material without elasticity and one that would cut into the tissues sufficiently to interrupt conductivity of

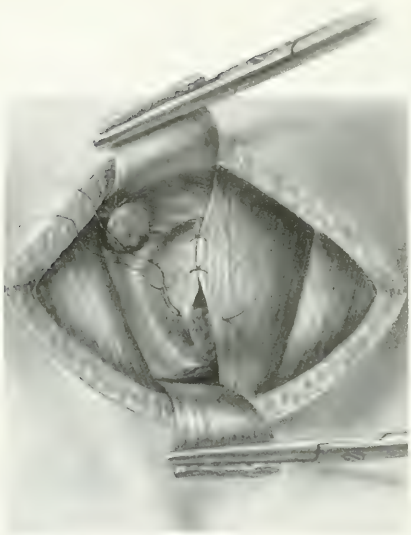

Fig. 9. Showing face to face folding of cut surface of thyroid remnant to control oozing, stitch passing through external surface of remnant and pretracheal fascia so that when knot is tied remnant is folded face to face on itself. In this illustration, first stage hemithyroidectomy only having been done, thyroid remnant is sutured to pretracheal muscle. Stump of thyroid on superior pole.

the sympathetic nerve in preliminary ligations. Although we have seen only three cases where this silk has caused trouble, we now feel that pyoktannin catgut possesses all of the qualities desired, being extremely strong, having little or no elasticity, and being, of course, absorbable.

The pole is then cut through about one-half an inch from the tie (Fig. 7), a small section of the very apex of the pole being left to prevent slipping of the ligature. With the cutting of the pole free delivery of the gland is at once possible. Another double hook is placed at the bottom of the gland and by traction inward on both double hooks the gland presents (inverted) and attached to the trachea only at its lower half or third. The middle thyroid vein is clamped, cut, and the posterior surface of the gland wiped down and examined carefully for parathyroids. By means of this procedure two important sections of the thyroid are exposed, one, the posterior surface of the gland and, the other, the inferior postero-internal portion of the gland adherent to the trachea and sheltering the recurrent laryngeal nerve in its course beneath the gland beside the trachea. Decision is made as to the amount of thyroid tissue to be left, as represented in Figure 3 by means of the dotted line, and pointed hæmostats are plunged into the gland (Fig. 7), starting either at the bottom or the top, each grasping a section of the gland within its jaws, each being applied on the level of the imaginary line represented in Figure 3 by the dotted line, until a line of snaps the jaws of which grasp thyroid tissue replace the dotted line in the figure. Each snap is applied in a horizontal plane so as to be quite accurately parallel with the table upon which the patient's neck is resting, thus avoiding the danger of catching the recurrent nerve in the points of the snaps which might penetrate the back of the gland were they plunged into the gland in any plane approaching a right angle to the plane upon which the patient's neck is resting. All of the sections of thyroid included in the jaws of the snaps are now cut through with a sharp knife and another tier of snaps applied to the remaining tissue (Fig. 8), until the trachea is reached, care being taken as with the preceding tier to apply them in the same horizontal plane. The isthmus is then removed in the same way, a little thyroid tissue being left on it if conveniently possible.

We wish to call attention to the method of holding the lobe of the thyroid, as shown in Figure 8, in applying the snaps in tiers. Notice that the thumb is applied to the external surface of the gland while behind the gland the index finger presses against the isthmus by means of which counter pressure much of the bleeding from cut vessels not included in the hæmostats may be controlled at will.

The advantages of the above procedure are, first, the fact that a definitely mapped out segment of thyroid is left behind, that section posterior to the dotted line in Figure 3, that this mapped out section protects the recurrent laryngeal nerve, that the mapped out section is protected from injury by the horizontally applied snaps and, finally, that the carefully exposed and sponged posterior surface reveals the location of possible parathyroids usually at such a site as readily to permit the inclusion and protection in the mapped out remnant to be left behind. The thyroid tissue having been cut away, each snap is ligated in turn with plain catgut, except when two or three may be ligated together without the inclusion of thyroid tissue, which might make possible an injury to the recurrent laryngeal nerve.

We have avoided the use of stitches in the thyroid remnant as it is our feeling that if success is

to be obtained in toxic goiter, particularly in the hyperplastic type of primary hyperthyroidism, large amounts of thyroid tissue must be removed, leaving only very small remaining segments of such thinness that to pass sutures through them would make possible an inclusion of the recurrent laryngeal nerve in the suture and interference with the blood supply of the parathyroids. These conditions we have been largely able to avoid, as evidenced by the fact that in over thirteen hundred thyroid operations we have had but three cases of tetany, these being only of the transitory type and all having been free from symptoms now for some months without treatment. Furthermore, we have had relatively little recurrent paralysis, we have never had a bilateral abductor paralysis and have never had to do a tracheotomy upon a patient having non-malignant goiter.

It has been our experience that even after the snaps which have been plunged into the gland are tied and after the gland is cut away, oozing may still persist at times and be of such character as to be uncontrollable by snapping, necessitating in such a case the employment of suture. In such a situation it is our custom to pass sutures only through the outer margin of the remnant well away from the area over the nerve, another bite being taken through the tissue over the trachea. After the knot is tied, the gland is so folded on itself that oozing is controlled by face-to-face pressure of the cut surfaces, Figure 9.

In closure of the neck it is our custom to suture the cut muscles with interrupted mattress stitches accurately applied about veins to control bleeding and to prevent postoperative hæmorrhage (Fig. 10). In the first half of our series of cases we took considerable pains to suture the platysma muscle, while in the latter half of our cases the platysma has been entirely neglected. We are now of the opinion that its suturing has no effect upon the scar and that because of the fact that it places additional catgut close to the cut skin it increases the incidence of serum pockets in the wound thus producing adhesions and interference with the symmetry of the scar.

We shall not discuss further steps in the technique of subtotal thyroidectomy, as it is the purpose of this paper, not to explain the technical steps of an operation already well known, but to present those developments which, in our hands, have added to the safety of the operation and lessened its complications.

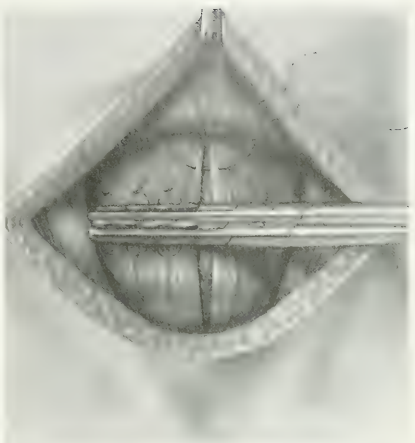

Fig. 10. Showing suture of prethyroid muscles by mattress stitch to control bleeding. Longitudinal suture of muscles in median line. Sternomastoids intact.

To epitomize our views:

1. We feel that if pole ligation is to be done in a sick patient too ill to endure more extensive surgery, we should be absolutely sure that the entire pole is ligated. In our hands the method most certain to accomplish this end is the one described above.

2. One should be certain that a large amount of thyroid tissue is removed, and equally certain that a definite amount is left behind. We feel that we have made certain of this by the inverting of the gland and application of the snaps so as to map out the part to be removed and the part to be left.

3. This technique has, in our hands, made control of bleeding satisfactory and certain, a factor which, in our opinion, has much to do with the elimination of tetany, recurrent paralysis, and many of the other possible complications of this operation.

FRACTURED SPINE; CONSIDERATION OF THE PRACTICAL CARE AND TREATMENT[1]

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THE subject of fracture of the spine has received a good deal of consideration from the standpoint of diagnosis and surgical treatment, in which instance the lesion itself has attracted the greatest amount of attention, while on the other hand there has not been enough interest shown in matters relating, as a whole, to the general care and welfare of the patient. No matter how well the operative or general surgical treatment may be directed, unless the entire course of treatment of the patient be taken into consideration the results are not likely to be favorable. It is a discussion of this latter phase of the subject to which I wish particularly to call attention. We shall be interested chiefly in the graver lesions in which the spinal cord is involved and in which there is a definite paralysis.

During the past 20 years in general hospital service as well as in the military service I have had occasion to treat a considerable number of cases of fracture of the vertebræ. All degrees and types have been encountered. For our purpose, however, I shall present only a single case which offers a number of interesting points for discussion. A brief synopsis of the history of this case is as follows:

Case 1.—Mr. J. J. L., aged 51, a mechanic, on August 4, 1919, while in an excavation and while straddling a pipe, was crushed by the wall which caved in and buried him completely. He was rushed to a hospital where it was found that he was in great shock, had suffered a fracture of the vertebræ, and that the lower limbs were completely paralyzed. The roentgen examination disclosed a pronounced dislocation of the third and fourth vertebræ and fracture of the transverse processes of these vertebræ (Fig. 13). He was placed on a Bradford frame and Buck's extension applied to both lower extremities. This form of treatment was continued for 3 weeks when a second roentgen examination was made, and it was found that the deformity was somewhat less (Fig. 14). On account of the irritation to the skin caused by the adhesive strips, the extension had to be discontinued, and he was placed in a fracture-bed. On October 15, 1919, I was called into consultation and noted the following condition: The patient was weak and emaciated, the ribs were prominent; the heart action was feeble and he was easily exhausted; he could not move the lower extremities. The knee-jerk and plantar reflexes were absent. The cremasteric reflex was present and was more marked on the right than on the left side. There was no anal reflex. Sensation was present on the anterior aspect of the right lower extremity and extended as far as the great toe and inner side of the right foot. There was some sensation on the interior aspect of the left thigh but not below the left knee. There was incontinence of urine and fæces. In the sacral region there was a large bed-sore. On November 11, 1919, when I was given complete charge of the case, the neurological findings were about the same and very slight muscle movement was detected in the right thigh. Foot-drop was pronounced. The heels of both feet were black. The bed-sore on the back was 5 inches in diameter and the muscular coat of the rectum and the bare sacrum were exposed. The margins of the bed-sore were undetermined for a considerable distance. There was œdema of the penis and of both lower extremities. He was able to be propped up in bed but was still very weak. Fæces were impacted in the rectum, and there was a pronounced cystitis. There was no control of the bladder or rectum.

Splints were applied to both feet and legs to correct the foot-drop and to relieve pressure on the heels. The bed-sore was strapped with strips of adhesive plaster to aid in drawing together the margins of the wound (Fig. 3). A strong and firm plaster shell extending from the shoulders

Fig. 1.—Decubitus following fracture of the spine. The large bed-sore exposes the sacrum and the posterior wall of the rectum. The wound margins are undermined for a considerable distance by sloughing necrotic tissue. (Service Unit 1, Washington University, City Hospital.)

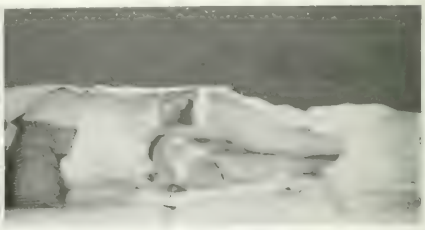


Fig. 2. Strong, well-padded and comfortable plaster shell applied to the back and held in position by a sand bag. The shell is cut away at the lower part to relieve pressure over the bed-sore and to permit of easy dressing of the wound.

Read in the section on Surgery at the Southern Surgical Association, Memphis, Tenn., December 1, 1920.

Fig. 3. Method of supporting and treating bed-sore by means of strapping, lattice fashion, with adhesive strips. The traction assists in the healing process and greatly diminishes the size of the bed-sore by approximating the true skin margins.

Fig. 4. Effect of treatment on a bed-sore which was over 5 inches in diameter. Wound almost entirely closed in by true skin. A deep, perforating trophic ulcer over the left tuberosity is indicated by a rubber tube for treatment with Dakin's solution.

to the hips was applied to give support to the back and to relieve pressure on the bed-sore (Fig. 2). The application of the cast occasioned a chill and tremors, though the temperature and pulse rate remained normal. On November 25, 1919, with casts and shell applied he was removed to his home and placed in a fracture-bed. The shell furnished a useful means of transportation. At his home the bed-sores received constant attention. The cystitis was treated and the bowels were kept properly regulated. A Balkan frame was installed early in December and the lower extremities were swung hammock-like in Hodgen splints, thus assisting in voluntary muscular movements (Figs. 5 to 8). The patient received massage daily. By December 29, slight adduction and abduction of the right thigh and flexion at the right knee were noticed and also slight adduction of left thigh. The œdema of the penis, scrotum, and hips had been reduced. At times there were shooting pains in the left limb. The patient grew fond of his shell and gained in general health and strength. By February 1, 1920, a deep, trophic ulcer had developed in the left buttock over the tuberosity, and all the other wounds showed improvement (Fig. 4). On February 11, the patient had a chill and the temperature was elevated to 102.6°F. There was a slight mucopurulent discharge from the rectum. On the following day the temperature was reduced, but there was a reddened area about the left hip resembling erysipelas. The area of redness migrated downward along the thigh and disappeared in 3 or 4 days.

On April 25 the patient again experienced severe shooting pains in both lower limbs, extending into the feet. The left foot was more painful than the right and a sedative was required to give relief. The next morning there was œdema and redness about the left hip. The inflammation again descended, this time as far as the foot. The right thigh was also reddened. The temperature was 100° F., pulse rate 100.

On May 6, 1920, the patient was taken to a hospital for roentgen examination and returned to his home, where on the next day a neurological examination made by Doctor W. W. Graves showed the following:

"The general nutrition is fair, though there is still marked general emaciation. There is marked wasting of the muscles of the lower extremity on the right, and so far as can be determined by palpation, there is no muscle tissue remaining in the right leg. There is fairly good quadriceps function. There is slight adduction and inward and outward rotation at the hip. There is also slight function retained in the inner hamstring muscles. There is marked tendency to foot-drop and supination of foot on the right, also on the left. No muscle tissue can be palpated about the left leg. Quadriceps group is wholly atrophied; abduction and extension of hip nil; adduction and inward rotation fair. It is noted that urinal is kept in constant position. Left knee-jerk is absent; right knee-jerk is present. Sensation on left to pin pricks and apparently in all other qualities of sensation is wholly abolished below the knee; retained about the anterior and outer aspects of left thigh and to the knee joint on the outer surface and to within 4 inches of the knee joint on under side. Sensation is preserved on the outer and upper third of right thigh, as to the right lower extremity sensation is profoundly disturbed about the outer surface of right leg and greater portion of foot; otherwise sensation is fair about this extremity. There is complete loss of sensation in the gluteal region in a zone corresponding to the distribution of the third, fourth, and fifth sacral roots. There is a scar over each heel from decubitus."

The roentgenologic report of Dr. E. H. Kessler was as follows: "The third and fourth lumbar vertebræ are dislocated, and there is a fracture of the transverse process and of the inferior articular process of the third vertebra. The fourth lumbar vertebra is fractured through the transverse process and the superior articular process is also fractured. The dislocation is lateral and anteroposterior."

A small rectal abscess developed which was operated on June 23, 1920. On July 8, there was slight voluntary flexion of left knee, though flexion of right knee was quite complete, and the entire right limb in extension can be raised and flexed at the hip.

On August 21, there were severe shooting pains in both lower limbs, the temperature was 101°F., and as on previous occasion redness of the skin developed about the hips and migrated toward the feet. The reddened area was painful and was hotter than the surrounding skin. This pain, elevation of temperature, and reddened skin recurred on October 22, and again on March 21, 1921.

Since July 23, 1921, patient has slept at night without a cast or shell. During the day he was placed in a wheel-chair (Fig. 10). Since November 14, by employing the abdominal muscles he was able to expel urine and regular catheterization was discontinued. On December 11, he was able with assistance to get out of bed and into the roller-chair without the use of his swing. He has daily taken exercises to develop the atrophied muscles and to regain locomotion. The rectal function has shown improvement and he now has moderate control. The bladder function is still inadequate though during the day he manages to hold the urine about 2 hours. During the night he is obliged to provide himself with a urinal. Since the patient has been able to be about, the bed-sores have healed, the shooting pains are less severe and he has improved markedly.

Fig. 6. Frame work, Balkan frame of home construction which has been erected over bed to facilitate the handling and treatment of patient.

Fig. 7. Method of supporting lower extremity by means of soft pads and pillows to prevent bed-sores. The heel should be kept free to avoid pressure sores. The atrophic muscles as well as other parts of the body are massaged daily and all joints are manipulated.

Fig. 7. A suitable fracture-bed permitting of easy elevation of trunk to sitting position and of satisfactory use of bed-pan by lowering of middle section. The trapeze enables the patient to lift himself thereby materially assisting the nurse in the care of the patient. An elastic supporter may be used to correct foot-drop.

Fig. 8. The frame enables various types of apparatus and treatments to be put to use. The sling for the leg permits of easy adduction and abduction of the lower extremity. The foot is always supported so as to correct foot-drop.

Cases of fractured vertebræ must be considered with regard to the treatment of the immediate condition and also with regard to the secondary and remote complications following injury to the spine and cord. The primary handling of the case is concerned with the treatment of shock, the reduction of fracture or dislocation either by manipulation or operation, the relief of pressure on the cord, the treatment of the bladder and the rectum when paralyzed, and the treatment of respiratory and cardiac complications. In certain cases it is difficult to determine whether or not resort should be had to immediate operation in order to relieve symptoms of compression of the cord. The subsequent care of the patient demands appropriate treatment directed toward the cure of bed-sores, trophic disturbances involving the different tissues, œdemas, abscesses, cystitis, neuritis and other nerve lesions, atrophy of muscles, and the prevention of infection and sepsis.

Patients suffering with fracture of the vertebræ and injury to the cord with paralysis die as a result of shock or paralysis of vital functions, or more remotely as a result of sepsis and a state of inanition. Bearing this in mind, special attention must be paid to all objective as well as all subjective symptoms. The incontinence of urine and fæces, decubitus, the results of trophic changes, pulmonary and cardiac symptoms demand very careful consideration and attention. As a factor in prognosis and treatment, due regard should be had for all subjective symptoms.

Fig. 9 (at left). Patient in shell elevated to sitting position thus relieving pressure on the back. The position improves the circulation and the general health of the patient. He is also thus enabled to feed himself.

Fig. 10. In the recumbent position the seat of the swing is placed under the buttocks. When the patient is raised to the sitting position the ropes and pulleys of the swing are adjusted. The back-rest having been lowered, the patient in the swing is easily elevated, the bed is removed to one side and in its stead is placed a roller-chair into which the patient is lowered. The bed-ridden patient is thus enabled to get about.

The patient's mental condition and habits should be studied, so that a hopeful attitude toward recovery may be encouraged. The character of the so-called root pains and the various nervous manifestations and sensations are often a guide as to the progress of the case. The root pains may be so severe that sedatives and even operation may be required to give relief.

The lack of proper bladder function is a very distressing complication. If possible cystitis is to be avoided and this condition is only too often invited by catheterization which a distended bladder seems to call for. Unless the pain and bladder distention are too great, catheterization should be avoided for fear of infecting the bladder. Overdistention of the bladder with incontinence is safer than faulty catheterization. When catheterization must be resorted to, the bladder should be irrigated with sterile boric acid solution and followed by argyrol, or other antiseptic solutions should be instilled to control infection.

The incontinence of fæces can be properly controlled. The stools should be kept soft, and this can be accomplished by the proper administration of liquid petrolatum or similar preparation. At times a cathartic may be required. A cleansing enema given daily will keep the patient in a clean and satisfactory condition.

The bed-sores (Fig. 1) are the result of trophic changes and long-continued pressure on the skin. In handling bed-sores pressure areas must be avoided. Alcohol, bismuth preparations, etc., which harden and toughen the skin are better than oils and ointments which soften the skin. I have found Dakin's solution and hyclorite solutions of appropriate strength, very efficient in cleaning up sloughing bed-sores. It may be necessary to employ tubes so that the wound may be frequently treated with the solutions. Large bed-sores

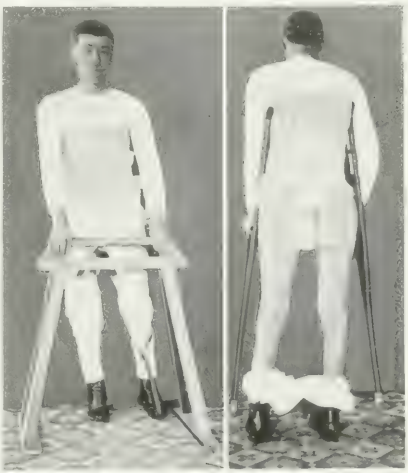


Fig. 11 (at left). Locomotion is enabled by means of the "perambulator" which when placed a short distance in front of the patient, enables him to drag himself forward or to take steps as in walking. The patient's back is supported by a corset which the writer had specially designed.

Fig. 12. The patient is also taught how to use crutches and in the beginning the tripod method of locomotion is most useful. The upright position permits the bed-sores to heal more rapidly. Weight-bearing strengthens the knees and also seems to re-establish the sense of equilibrium.

Fig. 13. Case 1. Very pronounced dislocation between the third and fourth lumbar vertebræ associated with fracture, causing immediate complete paraplegia. With appropriate treatment there was a gradual and also a marked restoration of function.

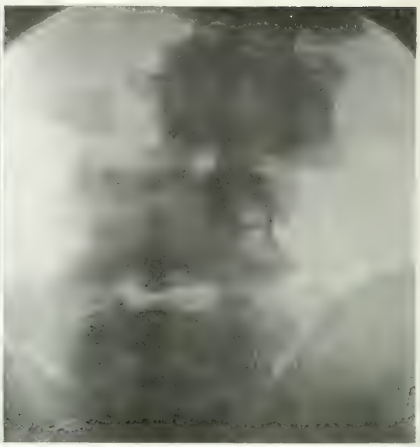


Fig. 14. Case 1. Shows improvement in alignment of vertebræ after application of traction for 3 weeks. (The author is indebted to Dr. M. L. Klinefelter for the roentgenograms, Figures 13 and 14.)

should be strapped, lattice fashion, with adhesive strips so as to approximate the wound-margins and thus to relieve tension and the tendency to enlarging of the wound (Fig. 3). Scarlet red ointment is useful in stimulating epithelial growth. Balsam of Peru in castor oil and other ointments are useful at times. Superabundant granulation may be controlled by the use of tincture of iodine. The healing of wounds is a special study, and each wound and often the different parts of the same wound, may require different treatment. It is often necessary to vary the procedure in the treatment of a wound according to its special demands and requirements. The importance of this latter fact is often not appreciated.

The therapeutic measures must be applied as the special indications require. Massage of the entire body and especially of the affected extremities is necessary to keep up the tone of the muscles and to keep the joints supple. Massage of the scars of healed ulcers is useful in making the skin mobile, pliable, and more resistant. The beneficial effects of massage cannot be overestimated.

A patient suffering a paralysis as a result of fracture of the vertebræ is so helpless that mechanical means is required to furnish aid and comfort. Appropriate splints or supports should be adjusted to the lower extremities to prevent decubitus and foot-drop (Figs. 7 and 8). The plaster shell is an efficient means of making the patient comfortable, preventing or treating bed-sores and of easy transportation and handling of the patient while in bed (Fig. 2). A properly applied shell also helps to correct deformity of the spine. When the shell may be dispensed with, a removable body cast takes its place. As the condition improves the cast is replaced by a plaster jacket or corset of special design (Figs. 11 and 12). An adjustable fracture bed is almost essential in the proper handling of the patient (Fig. 7). A properly constructed framework over the bed (Balkan frame) is so desirable that it should form a part of the equipment in treating the patient. The frame permits the patient to be supported and by means of pulleys, ropes, slings, splints, swings, etc., various movements of the body and limbs are made possible. The frame enables the patient to take the first steps toward getting out of bed, and thus hastens convalescence (Figs. 5 to 10).

The nursing of the patient with a fracture of the back is exceedingly important. There are many things regarding the proper care of the patient which are unusual and disagreeable and there is a great tendency to shirk responsibility. Often the cases are considered hopeless, and the nurses

and attendants show a lack of proper interest and perform their duties in a mechanical and perfunctory manner.

The inability of the patient to help himself and the difficulty of handling the patient make the case a trying one. It is the incontinence of urine and fæces that is the source of greatest annoyance, and in proportion to the mastery of these complications depends the success in the treatment of the case. The nurse who is successful in these cases knows the value of extreme cleanliness and care. The hair about the genitalia should be shaved so that the parts may be kept surgically clean. The urinal should be of the proper type so that leakage and soiling is avoided. The bowels must be kept properly regulated and cleansing enemas should be given daily. The bed clothing must be kept dry and clean. I have been able to train housewives for this type of nursing who have succeeded better than the trained nurse because of their extreme interest and attention to detail. The nourishment, hygienic surroundings, ventilation, and attention to the mechanical adjustments are important factors in the treatment. Extreme patience and care are required and when these virtues are made a part of the intelligent treatment, favorable results may eventually be expected.

In concluding I wish to make a plea for a more hopeful attitude in regard to the prognosis in cases of fracture of the vertebræ. Intelligent nursing, cleanliness, the proper care of the bladder and bowels are important factors in the treatment. The plaster shell, the Balkan frame, and a suitable fracture bed are also important adjuncts. In the treatment of bed-sores the surgeon must master the principles of wound healing. Attention must be paid to the patient's psychic condition, and occupational therapy in this type of cases finds an important place. The active and paralyzed muscles must be studied and the surgeon must select exercises and movements so that inactive muscles may be developed and so that proper re-education of muscles may be made possible. With attention to these details, the surgeon may sometimes be rewarded by a favorable outcome in a type of case of fractured spine that were considered hopeless.

A NEW SACRO-ILIAC SUPPORT

BY JOHN McWILLIAMS BERRY, M.D., F.A.C.S., ALBANY, NEW YORK

IT is possible to support and hold together a disarticulated human pelvis by the pressure of one or two fingers on either side (Fig. 1). The proper point for pressure on either side is limited to an area about 2.5 centimeters in diameter on the outer surface of the ilium opposite the knee of the sacro-iliac joint. If pressure is applied over any other two areas than the above the pelvis falls apart. Corresponding areas on the surface of the body are situated just posterior to the upper end of the greater trochanter of the femur and there are normally depressions in the buttocks at those points.

Many sacro-iliac supports that have been devised press against the crest of the ilium or other parts of the pelvis and tend rather to displace than support the sacro-iliac joints.

The object of the brace herein described is to give lateral support to the pelvis over the points at which experiment has shown that the disarticulated pelvis can be held together.

The brace (Fig. 2) consists of two pads, *A* and *A'*, joined by a thin bar or band of flexible tempered steel, *B*. The length of the steel band is such that the pads fit into the depressions on

Fig. 1. Disarticulated pelvis held together by pressure exerted by two fingers on either side.

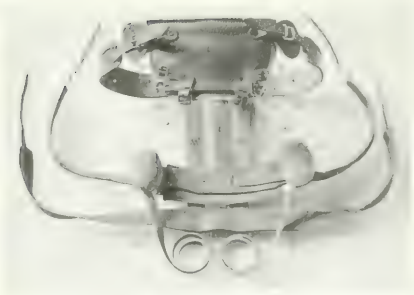


Fig. 2. Brace showing parts as described.

the buttocks which correspond to the proper points of pressure to support the pelvis. The strap, C, is attached back of the pad, A, between it and the steel band, and runs across the front of the steel band through a slit in the strap, C', and out posteriorly through a slit in the steel band near the pad A'. It is then brought around the body and is fastened to an abdominal pad, E, by a buckle at D'. A similar strap, C', runs from the pad, A', out through a slit in the steel band back of pad, A, and is fastened to the abdominal pad by a buckle at D. When these two straps are tightened, it will be seen (since the pads can not slide toward each other), the steel band bows backward and the pads exert lateral pressure. The lateral pressure is further increased by the pressure against the pads as the straps are brought around the body and fastened in front.

At the back of the brace a steel upright, F, is riveted to the flexible band already described and also to a second band, H, at the waist level of the body. From the ends of the waist band two straps, K and K', run obliquely down and forward just above the iliac crests and are fastened to the abdominal pad by buckles at L and L'.

From the back of the waist band two steel bars, M and M', extend downward on either side of the steel upright, F, connecting the pelvic and waist bands. The steel bars, M and M', are fastened together a short distance below the pelvic band but are not attached to it. When the straps, O and O', are tightened and buckled to the abdominal pad at P and P', the pelvic band which was previously bowed back is brought forward again thus giving the pads, A and A', a forward pressure in addition to the lateral pressure they were already exerting.

The straps R and R' are perineal straps that are fastened to the abdominal pad at S and S'.

AN INSTRUMENT AND METHOD FOR ASEPTIC ANASTOMOSIS OF THE INTESTINE[1]

BY FREDERIC E. B. FOLEY, M.D., ST. PAUL, MINNESOTA
Miller Hospital Clinic

IN 1910 the late Dr. William S. Halsted described an end-to-end suture of the intestine by what he termed a "bulkhead" method (1, 2),[2] its distinguishing feature being an essentially aseptic technique. In brief, the method consisted in abutting and suturing the ligated and seared ends of bowel with later re-establishment of the intestinal lumen by destruction from within of the obstructing bulkheads after completion of the suture. The method was presented as an experimental study and full cognizance was taken of the fact that it was only developmental, improvements and perfections in the technical details being essential before it could be accepted for use in the human subject.

With a view to stimulating interest in these desired improvements and in the problem of aseptic anastomosis in general, it was Dr. Halsted's habit to demonstrate this operation to the students in operative surgery at the Johns-Hopkins Medical School. The writer's interest in the subject began with one of these demonstrations. Other workers in the Hunterian Laboratory were already engaged in experimentation on the problem, among them the late Dr. Ernest Grey. By a cleverly contrived method of releasing the bulkhead ligatures [illegible] he sought to re-establish the bowel lumen after completion of the suture. The writer attempted to accomplish the same thing by amputating the ligated bulkheads by means of specially devised tonsil snares. Neither method, however, represented any real improve-

Fig. 1. Fig. 2. Fig. 3 Fig. 4

Parts of instrument and instrument assembled.

ment over Halsted's original scheme and the latter one gave less assurance of perfect asepsis.

At this time (spring, 1917) the writer proposed in the Hunterian Laboratory the design for an instrument to be placed within the invaginated bulkheads in such a way that, after completion of the suture, pressure on the instrument from without would cause it to cut through the bulkheads, thus re-establishing the intestinal lumen. Walter C. Burket, one of the workers in the Hunterian Laboratory of that time, has recently published the description of an instrument (4) in which the essential feature of the instrument proposed by the writer in 1917 seems to have been employed.

During the past year, Dr. Halsted described another variation of the method (5) for use in the large bowel. In this procedure the bulkheads are cut open by a protected knife passed up the colon from the anus. More recently (December, 1922) Collins (6) and Horine (7) have described methods for aseptic anastomosis. These, however, are only variations of the principle embodied in Grey's release ligature. One of these methods (Horine) has been employed in the human subject.

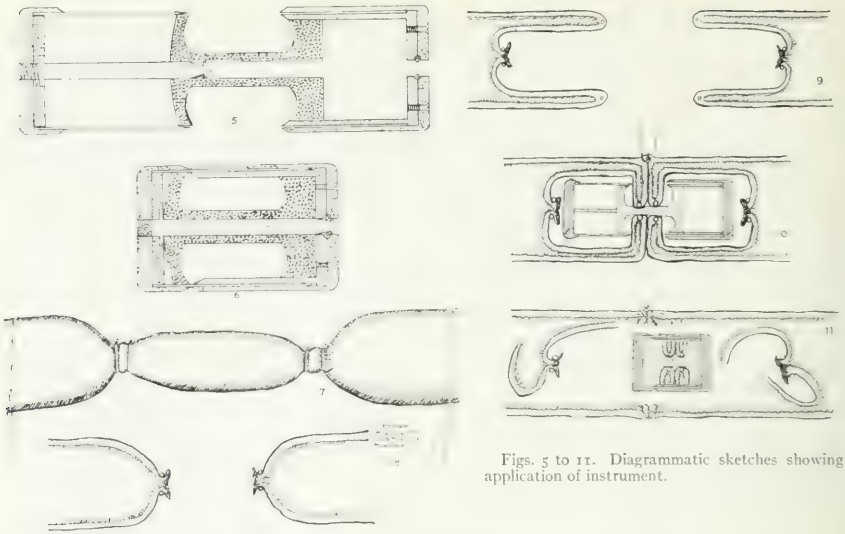
It was not until 1919, in the Laboratory for Surgical Research at the Harvard Medical School, that opportunity was afforded the writer to construct and experiment with the instrument, the design for which had been proposed 2 years previously. It is felt, however, that the instrument devised is a more practical development of the scheme than the instrument described by Burket.

DESCRIPTION OF INSTRUMENT

The instrument consists of the four members shown in Figure 1. The metal cup, c, fits into a similar but somewhat larger cup, d. The two are held together, as shown in Figure 2, by two small screws through their bases. One end of the spindle, b, Figure 1, fits into the inner one of these cups like a piston in a cylinder. The member shown in *a*, Figure 1, consists of a V-sectioned cylindrical knife blade held securely in a base. A round metal pin rises from the center of this base. In the assembly, Figure 2, this pin is shown engaged in the end of a hole which extends through the axis of the spindle. The instrument thus assembled may be telescoped together as shown in Figures 3 and 4. As the instrument collapses, the knife blade is received and encased in the space between the walls of the cups, one end of the spindle slides into the inner cup like a piston, while the other end is received within the knife blade. In Figures 5 and 6 the different parts of the instrument and their relations after telescoping are shown in cross section. The way in which the instrument locks in the telescoped position is also shown here; the groove near the end of the pin engaging a wire clip between the bases of the cups.

TECHNIQUE OF OPERATION

The portion of bowel to be resected is doubly ligated at two points, preferably with wire, Figure 7. Division between each pair of ligatures is made with the cautery, thus giving two sterile closed stumps of intestine, Figure 8. Some distance from the end of each stump a purse string suture is passed around the bowel. Each stump is now invaginated until the purse string is at the edge of the invaginated cuff, Figure 9. The instrument assembled as in Figure 2 is inserted into these two invaginations and the purse strings are tied down on the spindle, Figure 10. End-to-end suture of the abutted serous surfaces is now made. Interrupted mattress stitches are passed deep enough to include the submucosa. By including the submucosa, hæmostasis is secured and a strong line of union is made. On completion of the suture the segment of bowel containing the instrument is taken in the hands and pressed together in a longitudinal direction. As the instrument telescopes, the knife blade, beginning with the two points, is driven through the four thicknesses of bowel forming the bulkheads and their attachment at the suture line. In this way the obstructing bulkheads are cut out, the intestinal lumen re-established and the instrument liberated in the bowel cavity, Figure 11. The whole procedure has been carried out with complete asepsis, the bowel lumen having been opened at no time and not even a release ligature having been re-



Figs. 5 to 11. Diagrammatic sketches showing application of instrument.

moved through the suture line from the intestinal cavity after completion of the anastomosis. The instrument may now be milked along the intestinal tract to remove it from the site of operation. In fact in operations on the colon it has been found possible to move it into the rectum and expel it from the anus.

COMMENT

The present instrument was devised after experiment with two simpler, though less satisfactory, designs in which the spindle member was omitted. The first of these is more closely the plan of the instrument recently described by Burket (4). It consisted of two parts: one corresponding to the cups *c* and *d* in Figure 1, and the other a cylindrical knife blade the cutting edge of which was a complete circumference. The base of each part was flattened like a thumbscrew so that, as the two members were pressed together, the knife blade could be rotated back and forth. A secure grip on the thumbscrew shaped ends of the instrument was impossible because of the two thicknesses of surrounding bowel. The procedure gave an undesirable manipulation of the suture line. These difficulties made the contrivance impractical. It is difficult to see how they are overcome in Burket's device.

After some encouragement from the ease with which ordinary safety razor blades could be pushed through several thicknesses of bowel, a second instrument was constructed which dispensed with the rotating feature of the knife altogether. The groove into which the knife abutted was filled with paraffin as a block on which the layers of bowel could be cut, making contact of the blade with metal unnecessary. After completion of the suture, the two members were simply pressed together. The knife blades it was possible to construct did not approach in keenness the ordinary safety razor. With such blades it was soon found that the amount of pressure necessary to exert on the instrument in order to cut through the bulkheads, so damaged the bowel wall as to make the procedure impractical. With the two pointed knife of the final instrument this force is so reduced that no appreciable damage to the bowel wall results.

Though complete asepsis is not the *sine qua non* of intestinal anastomosis, it is sufficiently desirable to warrant investigation into methods capable of securing it. William S. Halsted considered it a sufficiently important problem to devote much time and thought to such experimentation. It may be said at once, however, that the amount of soiling which occurs with the ordinary methods

of intestinal anastomosis is not a factor of sufficient importance to warrant subordinating simplicity, speed, and strength of union (the Connell method) to a more involved technique the sole object of which is asepsis. Any procedure which secures asepsis at great expense in these matters will not be accepted for use in the human subject.

Operations on living dogs have shown the instrument and method described to be entirely practical within the limits of experimental surgery. Simplicity, speed, and strength of union are not sacrificed sufficiently at once to exclude the method from all possibility of employment in the human subject. Further perfections in the device and possibly in the details of the technique should first be developed.

Familiarity with the procedure described convinces that, though based on a seemingly complicated mechanical device, it is no more difficult or involved than anastomosis by the ordinary methods. The mounting of the bowel on the instrument in position for suture has proved very convenient. Anastomosis by the usual methods is made by a through-and-through suture in order to insure hæmostasis and firm union. In actual experiment with this method, it has been found that if a single row of serous-serous mattress sutures, including the submucosa, is employed, no appreciable bleeding results[1] (the operator learns to feel the resistance of the submucous coat). Upon sacrificing several animals after intestinal suture of this sort no evidence of leakage could be found (1, 3, 5, 10 and 30 days after operation).

The question may be raised as to the actual asepsis of the ligated and cauterized stumps of bowel. We have no bacteriological data bearing on this subject, but it is difficult to believe that organisms can survive a heat sufficient to char the tissue and material surrounding them.

The amount of bowel sacrificed in making the bulkheads might preclude the use of the method in certain situations.

One difficulty experienced was the tendency of the submucous coat to be dragged into the crevice between the cups at the points where the V's of the knife cut through the bowel. With the blade well sharpened this did not occur. The difficulty can be entirely overcome by a well-sharpened knife blade of high grade steel fitting snugly into the crevice between the cups.

Steel construction of all the parts gives the instrument undesirable weight. Aluminum can be used for all except the knife blade and grooved pin. An instrument embodying these improvements in construction and materials was to be made before making a formal report. The present paper is published at this time, however, in the interest of the writer's priority and because it is felt that it gives a technique of aseptic anastomosis superior to those recently described.

[1] For a critical comparison of the real merits of penetrating and non-penetrating sutures in intestinal anastomosis, see page 360 of the article (5) by Halsted.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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JUNE, 1923

THE LIMITATIONS OF CÆSAREAN SECTION

IT is an established fact that the scope of any surgical procedure widens as the technique is perfected, and as the mortality and morbidity are reduced. Cæsarean section has not been an exception to this rule, and because of the popular belief that it has been made a comparatively safe procedure, there is no doubt but that serious abuse of the operation is now prevalent. It is being performed upon unsuitable cases, in unsuitable surroundings, by surgeons who apparently disregard the wonderful adaptability of nature, who ignore the other tried and established obstetric procedures, and who seem to justify its employment upon surgical grounds rather than upon the obstetric indications for operative interference.

The outstanding fact to be kept in mind in estimating the true value of cæsarean section is that the perfection of operative technique has been by no means the only important factor in reducing the mortality. It has been markedly reduced only in properly selected cases; and when due regard has not been paid to the complications that may arise so insidiously in delayed labor, it promptly approaches a figure that places cæsarean section among the most serious abdominal operations. The average mortality in selected cases is estimated at about 2 per cent, and many obstetricians have reported large series with no fatalities, but the records of the average hospital will show a mortality of more than 10 per cent, and superior operative technique cannot altogether explain this discrepancy. The ideal results reported by Reynolds, Kerr, Williams, Hirst, and others are obtainable only when the operation is performed at the elective time on properly selected cases. The fact is not always appreciated that the risk increases hourly after the onset of labor, approaches 10 per cent after the second stage is well established, and may reach 25 per cent in exhausted or infected cases. Moreover, Kerr and Holland's recent exhaustive study shows that the mortality reaches 27 per cent when forceps delivery has been attempted prior to the operation. In view of such facts it must be admitted that cæsarean section has its limitations, and these figures prove that wide experience and judgment in the selection of cases are as important factors as is the operative technique.

Aside from the unwarranted risk attending the operation in improperly selected cases, the question of future pregnancies must be considered. Rupture of the uterine scar in subsequent labor occurs too often to be ignored. If it is agreed that only women who have had a normal convalescence following abdominal delivery should risk a subsequent spontaneous delivery, about 40 per cent of our cases would require a repeated section. This fact alone

prompts the conscientious obstetrician to urge definite indications for abdominal delivery.

Contracted pelves present perhaps the most definite indication for the performance of cæsarean section, but even here the best authorities agree that 75 per cent or more will deliver spontaneously if serious disproportion does not exist. This cannot be too forcibly emphasized at this time, when the indications for operative interference appear to rest largely on the fact that there is a contraction, regardless of the degree. Careful pelvimetry prior to the onset of labor, and section, if necessary, at the elective moment is the only wise course in such cases; the decision should be made before, and not after, labor has progressed until it is a question of performing cæsarean section or doing craniotomy as a last resort.

Craniotomy still has its indications in protracted labor, and while it is repugnant to destroy a living child, so should an abdominal operation be that demands such a heavy toll as is usually paid in exhausted or infected women. Its useful, if limited, field must be recognized in neglected or infected cases, for when properly done, mortality rarely approaches that of cæsarean section in similar instances.

It was hoped that extraperitoneal section would solve the difficulties encountered in neglected and infected cases, but while the mortality has been somewhat reduced, the results are not what had been anticipated. Section combined with hysterectomy probably gives the best results under the circumstances, but it is a frightful price for a young primipara to pay on the supposition that she may develop a serious infection.

The treatment of placenta prævia by cæsarean section has not been so satisfactory as to warrant its present frequent performance. Capable obstetricians such as Blacker, Hitschmann, and Williams report a mortality of less than 3 per cent by established methods other than section, and in view of the fact that the fetal mortality will be high in any event, owing to prematurity and the complications incident to low placental implantation, abdominal section should be reserved for the exceptional case and should not be the routine treatment of election.

Perhaps the greatest abuse of the cæsarean operation has been in the treatment of eclampsia. Many surgeons still advocate it almost as a routine treatment, in the face of the fact that the maternal and fetal mortality is still above 30 per cent, and that competent obstetricians are reporting results by palliative measures never equalled by the advocates of abdominal delivery. Its occasional employment in eclampsia is amply justified, but its routine application is a sad commentary in the light of available statistics.

When we read of the employment of cæsarean section for various malpresentations—in Holland's recent review its employment for impacted shoulder produced a maternal and fetal mortality of 50 per cent—hydramnios, hydrocephalus, primary uterine inertia, asthma, varicose veins, and epilepsy, we can form a just estimate of its widespread abuse. We have no idea of condemning the operation when it is indicated and properly performed. We have presented the subject merely to point out the need of a campaign of education to correct the impression of its safety, to define more clearly the indications and complications, and to attempt to standardize a useful operation which is being indiscriminately employed without a proper knowledge of fundamental obstetric principles.

C. Jeff Miller.

THE OPERATIVE RISK IN CASES IN WHICH THE FLUID IN THE COMMON DUCT IS COLORLESS

THE term "white bile," which is a misnomer, is applied to the colorless liquid occasionally found in the obstructed common and hepatic ducts.

The factors incident to the production of white bile have been a matter of conjecture, although Rous and McMaster, in 1921, were able to prove experimentally that it is a secretion of the mucosa of the biliary passages, and occurs in obstructed ducts which are not connected with a functioning gall bladder, that is, a gall bladder which is concentrating its contents by absorption. In several animals obstruction of the common duct was produced in such a way that the gall bladder still communicated with the channels in stasis; in these instances, it was observed that the bile was heavily pigmented and syrupy, ropy, or tarry, according to whether the period of obstruction had been long or short. In several dogs, cats, and monkeys, the common duct and the neck of the gall bladder were obstructed, or one or more of the large hepatic ducts were tied and cut separately. The stasis fluid in these cases was at first brown, then green, but definitely less pigmented, and finally after 10 or more days of stasis, became clear and often completely colorless. In several dogs a portion of the common duct was isolated by ligating and cutting it above and below. At various periods up to 12 days, this isolated segment was examined and found uninflamed, but greatly distended in every case, and it contained colorless, watery, or mucinous fluid. All of the animals became jaundiced, but none of the duct fluid was bile-stained, and cultures of this fluid were negative.

Berg, in 1922, in his monograph on the biliary system, expressed the opinion that white bile must be due to some cause other than obstruction as, in a large number of cases, a similar obstruction produces dark, concentrated bile. This, however, does not contradict the deductions made by Rous and McMaster, since the function of the gall bladder in Berg's obstructed cases apparently was not taken into consideration.

Kausch, in 1911, reported a case of white bile in which he operated, and 13 cases collected from the literature. He believes that white bile is a secretion of the mucosa of the biliary passages which collects as a result of obstruction, when the secretion of the mucosa of these passages is greater than can be resorbed. He says that when a certain pressure is reached in the bile ducts, the direction of the flow in the liver is reversed, that is, the bile formed by the liver cells and the bile in the passages pass into the lymphatics and blood vessels. As a result of this and the continued secretion of the colorless fluid by the mucosa of the biliary passages, the liquid in these passages becomes lighter and lighter, and finally colorless. In none of these 14 cases was the obstruction due to stone, and Kausch believes it unlikely that obstruction by stone would result in white bile.

A study of the patients with this condition who have come to the Mayo Clinic seems to bear out the conclusions of Rous and McMaster, based on their experiments on animals. There were 19 cases of white bile among 649 operations on the common and hepatic ducts during the past few years. In 9 of these the obstruction was due to stone in the common or hepatic duct, and in 6 to trauma at a previous operation; in 2 the obstruction was due to carcinoma (one of the pancreas and one of the ampulla); and in 1 it was due to pancreatitis. In one instance the white bile seemed a result of cholangeitis. In every instance in which

the gall bladder was present, it was apparently functionless as a result of inflammation.

As might be expected, jaundice was a more or less constant manifestation. It is not known how quickly the contents of the common and hepatic ducts become colorless. In this series of cases, the shortest period of continuous jaundice before operation was 2 weeks; the longest period was 1 year, the average duration 16 weeks. Seventeen of the 19 patients were intensely jaundiced at the time of operation and there had been no recent decrease. One of the patients who was not jaundiced had a biliary fistula; another was not jaundiced, although the common duct was completely obstructed by stone. In the latter, choledochotomy with removal of stone, and cholecystectomy resulted in drainage of bile on the fourth day, but the patient died on the thirty-second day after operation from acute hæmorrhagic pancreatitis.

One of the cases was rather unusual. The gall bladder contained green, watery material, while the common duct contained fluid without a trace of bile pigment. This patient had been having gall-stone colic at intervals for a year, but had been jaundiced only 2 weeks. At operation marked cholecystitis was found. The common duct was twice normal size, and the glands along the ducts were greatly enlarged. The gall bladder had been cut off by an inflammatory process, and the contents of the biliary passages became colorless before hydrops of the gall bladder could be produced. Cholecystectomy and choledochotomy were performed, and at the close of the operation the drainage was bile-stained. As a rule, bile appears in the ducts in a remarkably short time after drainage is established. In this series bile appeared in the first 24 hours in all but 1 case; in this case, no bile drained until the fourth day. In several cases, the common duct contained only colorless fluid, but by the time the operation was completed the drainage was bile-stained.

It cannot always be assumed that white bile in the ducts indicates that the liver has ceased to function. In only 1 of the 19 cases, the liver was probably not secreting bile. There are two definite reasons for believing that the liver does not necessarily cease to secrete bile: first, the elimination of bile in the urine would result in a decrease in the jaundice; second, if the liver had ceased to secrete bile, it would hardly resume that function so readily after drainage is established. It is well known to surgeons that if bile does not appear soon after the establishment of drainage of the common duct, in deeply jaundiced patients, the outlook is not favorable. In two of our cases which did not recover, there was only very slight drainage for a few days, and then it ceased entirely.

The presence of a colorless liquid (without bile pigment) in obstructed common and hepatic ducts, undoubtedly indicates a serious operative risk even with cautious pre-operative measures and postoperative care, including calcium, transfusions, and so forth, as the mortality in this series was high. It is believed that while the mortality is high, it probably is no higher than it would be in a series of cases of complete biliary obstruction of the same duration with green bile in the common and hepatic ducts. Cases presenting white or colorless fluid in the ducts are not necessarily doomed, as this finding does not mean that the liver is interfered with more than in any deeply jaundiced patient. The colorless fluid, or so-called white bile, is a product of the glands of the duct wall. It is secreted under sufficient pressure to continue to form, regardless of the secretion of bile from the liver, and it collects in the ducts only when the activities of the gall bladder are destroyed.

E. Starr Judd.

MASTER SURGEONS OF AMERICA

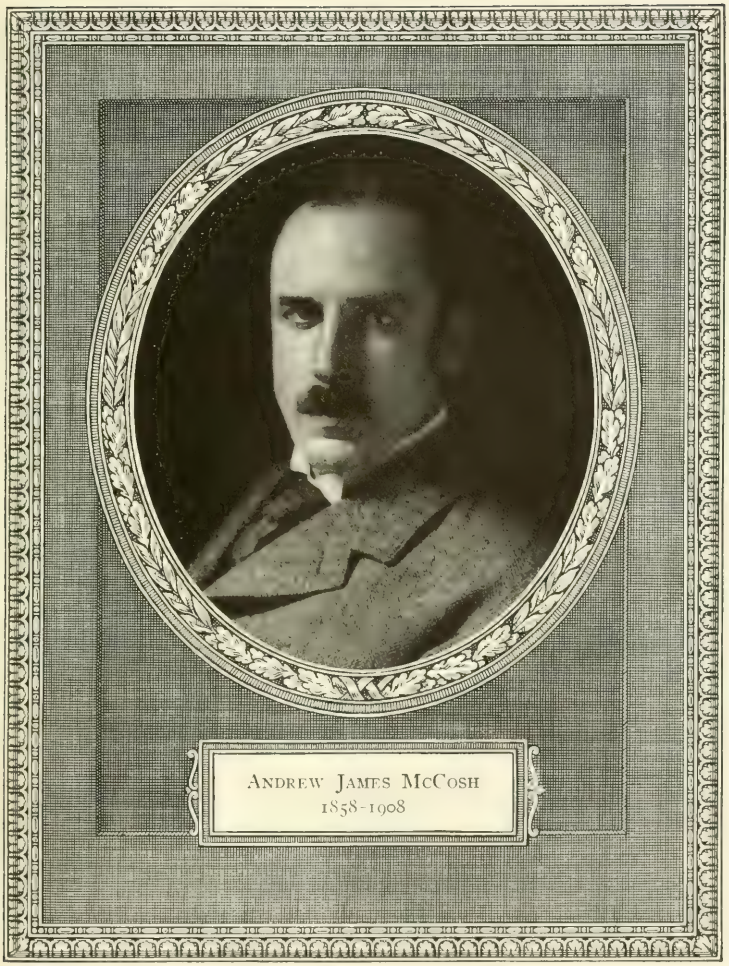
ANDREW JAMES McCOSH

DR. ANDREW JAMES McCOSH was one of the best loved surgeons who has ever honored the medical profession of New York. He made a very deep impression upon the thoughts and hearts of his contemporaries, and he died without an enemy. He was a Man! No one was born with a more compelling personality than Dr. McCosh. His Scotch ancestry dominated in that he inherited those sterling qualities of perseverance, and noble ideals; he never lost his "canniness" nor his broad Scotch accent.

On his mother's side he was the grandson of Dr. Alexander Guthrie, for many years a prominent surgeon of Edinburgh. His mother was the saintly Isabella Guthrie McCosh, who, long after her husband's death, was the Angel to many a Princeton lad in illness and distress. His father was Dr. James McCosh, the president of Princeton University, who, though a conspicuous Scotch divine, fought valiently for the doctrine of evolution.

Dr. Andrew McCosh was born in Belfast in 1858 and came to this country in 1868, when his father was called to Princeton as president of the University, then the College of New Jersey. Here he grew up and prepared for college, from which he was graduated with honor in 1877, receiving an A.B. degree. That he was an active, mischievous undergraduate is instanced by the fact that he, together with some sophomores, robbed his august father's hen roost, for which he was soundly thrashed. He was very athletic, being on the football teams of 1874, 1875, and 1876, and captain the last year. His superb physical development stood him in great stead later, for he was tireless in the exertions incident upon a large hospital and private, surgical practice. He was an honor man in junior year and delivered the Modern Language Honorary Oration at Commencement. In 1880 he received an A.M. degree at Princeton.

He studied medicine at the College of Physicians and Surgeons in New York, receiving his M.D. degree in 1880, being one of the ten honor men of his class of 160 members. During his interneship of one and a half years in the Chambers Street Hospital, he was afforded unusual opportunities for active, accident, and surgical service. After a year in post graduate study at the University of Vienna under Billroth, at that time the greatest surgeon in Europe, he started practice in New York City, in 1883, associating himself with Dr. T. Gaillard Thomas, at



ANDREW JAMES MCCOSH
1858-1908

that time the most prominent gynecologist in New York. This association lasted for 11 years. The temptation for him to specialize in gynecology must have been very strong, but Dr. McCosh's training on broad, general surgical lines had been too great to cause him to limit himself to any specialty. His best work was done in gynecology, yet he is not known as a gynecologist; his activities concerned themselves with all the problems of general surgery.

In 1887 he was made an attending surgeon to the Presbyterian Hospital, New York City, which position he held until his death. There he held his clinics, first, as professor of clinical surgery in the New York Polyclinic until 1895, after which he became clinical professor of surgery at the College of Physicians and Surgeons. From 1903 until his death, he was president of the Medical Board of the Presbyterian Hospital. For 2 years he was president of the New York Surgical Society. In 1904, in recognition of his work, Columbia University conferred upon him the honorary degree of doctor of laws, and in 1906 Princeton gave him the same degree. In the American Surgical Association, in the New York Academy of Medicine and in the Clinical and Practitioners Societies, his papers and discussions were listened to with great interest and respect.

In appraising a man like Dr. McCosh, two characteristics must be considered; first, personality, and second, professional ability. His personality was characterized by charm to the highest degree, and his rugged, outspoken opinions, which won for him lifelong friends, were given in so tactful a way that offense was never created. He was a man of decided opinions, yet he never had an enemy. This was due in a large measure to his inherent honesty and straightforwardness. He never became entangled in medical politics.

Dr. McCosh spent his summers in travelling in Europe; in consequence, he was an intelligent, well-rounded, thoughtful man of affairs. Perhaps his noblest quality was his kindliness. The last thing he thought of was money and his benefactions were innumerable. Frequently a patient, who had met with reverses, would be sent into a private room with the understanding that it was free, while Dr. McCosh would himself pay for the room and the special nurses.

His intuitions were extraordinary, and this, combined with perfect poise and entire absence of irritability, made him master of all trying situations. Doctors associated for years with Dr. McCosh never saw him angry nor ever heard him use a profane word even in the most trying circumstances.

His modesty was phenomenal and very unusual. He never pushed himself forward. When he made an address at a surgical meeting, his remarks were brief, concise, and pregnant, and his admirers felt that he rarely did himself full justice in public. To the poor he was always a dear friend; no one in any kind of trouble ever appealed to him in vain. He avoided heated arguments and discussions, and was conciliatory without any trace of weakness. He was saved from embarrassing entanglements by his superlative intuitions.

grown equally in length with the tibia, although it appeared longer than the normal. As was pointed out in the roentgenogram concerning the last case reported by the essayist, the fibula appeared farther from the knee joint than normally. In the specimen being passed around, the head of the fibula is close to the knee joint and the fibula unquestionably took part in the overgrowth in length as well as the tibia.

Dr. Frank Pierce: With regard to the fibula, those who have studied the plates in these cases will see that the fibula shows an increase in length the same as the tibia. They are longer than the fibula on the opposite side. Many such overgrowths are found in the leg.

We know that in many cases of delayed union in fractures, weight bearing and irritation will cause the fracture to unite. I believe that to a considerable extent ossification at the epiphyseal line will occur earlier as a result of weight bearing than in cases of diseased bone or normal bone upon which no weight is borne for some years, and that the lack of weight bearing in these cases contributes largely to their overgrowth.

Dr. D. B. Phemister: It is well known that a chronic inflammatory process in an extremity may produce lengthening of a bone even when it is situated in another structure. In chronic osteomyelitis of the femur, the tibia and fibula on the affected side may be considerably longer than on the unaffected side. No doubt the long standing hyperæmia of the extremety is definitely related to this bony overgrowth.

Dr. Daniel N. Eisendrath: An interesting point in relation to chronic infection of bone takes place in the kidney. Quite a few cases have been described of bone formation in chronic suppurative conditions of the kidney and show what Dr. Speed has brought out, that under the influence of chronic infection in osteomyelitis through some metabolic disturbance, bone formation takes place in organs where we would not expect to see it otherwise.

Dr. Speed (closing): I do not think Dr. Straus' point is very well taken because in the innumerable injuries of joints, especially in the epiphyseal region around the knee joint, we have not frequently found the overgrowth. The injuries must be very common, but the overgrowths are not very common. If I have seen three cases, there must be 300 lying around the city not noticed, because we do not look for them. Overgrowth does follow fractures of the femur in children, and I have seen at least 20 cases. Nature does make up shortening in children, and the bone simply responds to weight shortening and other stresses in accordance with Wolfe's law of the growth of bone.

In answer to Dr. McWhorter's question, I do not know why the fibula overgrew, except it was dragged along with the tibia.

Dr. E. Wyllys Andrews read a paper entitled "Technical Problems in Stomach Surgery."

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

THREE recently published volumes[1,2,3] on the subject of the thyroid gland reflect the particular interest that it presents to the surgeon.

Dr. Hertzler's monograph on diseases of the thyroid gland presents three particularly commendable features—a number of clear-cut illustrations of the gross and microscopic changes in thyroid disease, a well illustrated section describing the anatomy of the thyroid and the technique of operation, and a carefully written chapter by Dr. Victor Chesky on the hospital management of goiter cases.

The author states in his preface, "This study of clinical symptoms and pathological specimens has brought convincing evidence that the activity of the interstitial cells is associated with a definite clinical type of thyroid intoxication." In discussing the pathological changes in goiter he describes an increase of the interstitial cells as constantly present in some part of the gland in colloid goiter, and as dominating the picture in individual instances. He has often found in both "glandular" and "papillary" types (the former referring to the microscopic picture seen in toxic goiter without eye signs, the latter to that seen in exophthalmic goiter) a diffuse infiltration of interstitial cells. Finally, he has found in cases termed "formes frustes" a marked increase in interstitial cells, and suggests the possibility that these cells represent one component of what is actually a compound gland. The fact that these cells are constantly present in colloid goiter, that they are often found in both types of toxic goiter, and that they are markedly increased in that type of case in which there is a reasonable doubt as to the causative part played by the thyroid gland, make it difficult to correlate the presence of interstitial cells with a definite type of thyroid intoxication.

With reference to the diagnostic value of a determination of the basal metabolic rate the author states, "I have seen a number of discharged soldiers with the diagnosis of irritable heart or some such diagnosis when the patient was typical Basedow, eyes hanging on their faces, eye signs, tremor, tachycardia, goiter, and whose goiter after operation showed the typical histological changes. Because there was no notable increase in metabolic rate, thyrotoxicosis was declared to be absent."

To take out one lobe only, as the author suggests, in cases showing definite thyroid toxæmia, or to leave behind, in such cases, thyroid tissue as large as a normal lobe, would seem an almost certain way of inviting failure. With a toxic gland, the object of surgical treatment is to rid the body of the substance producing the toxic material, and to leave only a sufficient amount of thyroid to supply the body needs. The constantly improving results in the surgical treatment of thyroid disease have been definitely associated with the more general adoption of subtotal thyroidectomy as the treatment of choice.

An interesting collection of papers from the clinic of Dr. Crile and his associates reflects the successful methods with which the problem of goiter is being attacked in Cleveland. The outstanding impression which one gains from reading them concerns the infinite care and attention to detail that have been devised and employed to lessen the risk of operation for goiter, and to protect the patient before and after operation.

The most interesting chapters to us were those entitled, "The Value of Basal Metabolic Studies in Goiter," by Chester D. Christie; "The Prevention of Simple Goiter in Man," by O. P. Kimball; a short chapter on "Pre-operative Management of Exophthalmic Goiter," by W. R. Goff and E. O. Rushing; and a chapter on "The Postoperative Treatment of the Exophthalmic Goiter Patient," by Frank S. Gibson.

One statement by Dr. Christie is of particular interest, as contrasted with the idea of Dr. Hertzler, quoted above, concerning the value of the basal metabolic rate determination. "It seems certain that an increase in basal metabolism represents the fundamental and basic symptom of exophthalmic goiter, just as a hyperglycemia represents the basic symptom of diabetes mellitus."

The second edition of Crotti's *Thyroid and Thymus* is a worthy example of the best American book making. It is attractively bound, well printed on glazed paper, and illustrated with numerous clear half-tones and beautifully colored plates. It is practically an encyclopedia on the subject of the thyroid and thymus, so completely does it review the experimental and clinical work that has been done on these subjects. In addition, it

[1] DISEASES OF THE THYROID GLAND. By Arthur E. Hertzler, M.D., F.A.C.S. With Chapter on Hospital Management of Goiter Patients by Victor E. Chesky, A.B., M.D. St. Louis: C. V. Mosby Co., 1922.

[2] THE THYROID GLAND [illegible] OF GOITER. By [illegible] ASSOCIATES. Edited by Amy F. Rowland. Philadelphia and London: W. B. Saunders Co., 1922.

[3] THE THYROID AND THE THYMUS. By [illegible], M.D., F.A.C.S., LL.D. Philadelphia and New York: Lea & Febiger, 1922.

contains an exhaustive bibliography of the voluminous literature.

The chapters devoted to the operative treatment of thyroid disease are particularly well written, and well illustrated. The technique of operation in different types of goiter, the pitfalls and dangers that await the surgeon, and the method of meeting various complications that arise, are clearly described, with appropriate illustrations.

In view of its excellence and completeness it may seem ungrateful for the reader to mention shortcomings that occur to him. He is impressed, however, with the fact that so much space is devoted to the mediæval history of the thyroid, and so little to the modern. Very little space is devoted to the subject of basal metabolism with reference to thyroid disease, very little to radiotherapy, none to radium therapy. On the other hand considerable space is devoted to serum therapy, gland grafting, and experimental work that is chiefly of historical interest.

Hertzler states in his book that the history of a goiter patient ends only at his death. He leaves one with a distinctly somber impression as to the ultimate results of treatment of thyroid disease. We had hoped to find in Crotti's work the answer to this statement, but aside from statistics as to the immediate postoperative mortality there is little information concerning the late results of surgical treatment. S. L. Koch.

CORRESPONDENCE

ABDOMINAL CORSET

To the Editor: I wish to call the attention of your readers to the advantages of a simple abdominal corset that we have used in this hospital for many years with great satisfaction.

The corset consists essentially of two strips of rather heavy cardboard cut 1¼ inch wide and from 6 to 8 or even 10 inches long, according to the size of the patient. Into these strips of cardboard I have a shoemaker set a row of shoe hooks spaced about 1½ inches apart. The nurses then cover the strips of cardboard with sheets of adhesive plaster leaving the muslin on the plaster except where it covers the cardboard until it is applied. The plaster strips are cut as wide as the cardboard is long, and the plaster from 8 to 12 inches long

As soon as the laparotomy dressing is applied to the wound, the muslin is peeled off the plaster and the two strips of plaster applied evenly and firmly to the patient's abdomen leaving a space of perhaps 1 to 2 inches in the median line which will be taken up by the lacing. A narrow tape or corset lacing is then applied and the two strips of plaster laced evenly and firmly together. To inspect the wound or change the dressing it is only necessary to unlace the corset.

This is the most comfortable and satisfactory abdominal dressing I have ever seen. It also makes an admirable obstetric binder.

J. C. Heney, M.D.

Winchendon, Mass.

INTERPOSITION OPERATION FOR UTERINE PROLAPSE

A Correction

To the Editor: There is an omission of some considerable importance, presumably due an oversight on my part, in my note on the above subject, which appeared in the January, 1923, issue of Surgery, Gynecology and Obstetrics, p. 110. After mentioning the results that we can properly expect to follow the interposition operation, I go on to refer to what we cannot expect it to do in the following words: "But it (the interposition operation) may not be expected to offer a barrier to the descent of the cervix, once the body has begun to atrophy, or when it is already atrophied." To this sentence should be added the words—"or when the utero-sacral ligaments are lengthened." The necessity for this addition is obvious from the rest of the note, but it is well to emphasize the point. Henry Jellett.

Christchurch, N. Z.

AMERICAN COLLEGE OF SURGEONS

A VISIT TO THE SURGEONS OF LATIN AMERICA

I. The Foreword

By FRANKLIN H. MARTIN, M.D., F.A.C.S., Chicago

1. INTRODUCTION

THE sailing on the *S. S. Vandyck* from New York on February 10 of two hundred and seventy-five citizens of Canada and the United States, including Fellows of the American College of Surgeons and members of their families, for a cruise to Central and South American countries, was not merely the carrying out of a plan for a winter pleasure trip, but it was the culmination of a well-thought-out program to obtain a closer affiliation between the surgeons of North and South America, and to strengthen the foundations of a strong continental union through Fellowship in the American College of Surgeons.

The first step of this program was accomplished in the winter of 1920, when Dr. William J. Mayo and the writer visited the surgeons of Panama, Peru, Chile, Argentina, and Uruguay, and was pursued in the winter of 1921, at which time Dr. Thomas J. Watkins and the writer revisited these countries, adding to the itinerary Rio de Janeiro and São Paulo in Brazil.

In the meantime we had been generously received, and strong friendships had been created. More than one hundred of the leading surgeons of Latin American countries had become Fellows of the American College of Surgeons, and a large number of these southern surgeons had reciprocated by visiting us in the United States and Canada.

The story of our previous visits and the friendships we had been creating had deeply interested not only the members of the medical profession of our countries, but as well the men of broad vision in our State Department whose principal object it is to maintain a sympathetic friendship between the Governments.

2. THE START

And so, on the tenth of February, at twelve o'clock noon, we had gathered on the snow-covered deck of the *S. S. Vandyck*, our chartered ship, and amid snow-balling, still and motion picture taking, rejoicing and good-byes, we departed from our friends who stood on the dock. We slowly made our way as we reviewed the panorama of the shore line of a great city of the world, gave a farewell salute to the Goddess of Liberty, said adieu to zero weather and snow-storms, and sailed on to summer seas and tropical charm.

3. OUR CARGO

Fellows of the American College of Surgeons and members of their families and friends, bringing the number up to two hundred and seventy-five, comprised the bulk of the cargo. In addition we carried ballast of through freight and food and water supply. The College had representatives from thirty-five states of the United States and five provinces of Canada. Of these, eleven were Founders of the College, nine Governors, one Regent, and Dr. John George MacDougall, vice-president, and acting president for the period of the cruise.

4. THE SHIP

The *S. S. Vandyck*, with a displacement of 21,000 tons, the largest, newest, and most luxurious of the Lamport and Holt Line steamers, with her competent and genial Captain, John Byrne, whose character possesses the best the name implies, to guide her maritime destinies, furnished us a palatial floating hotel which, stripped of second-class and third-class passengers, afforded not only most satisfactory living quarters, but an abundance of deck space for exercise and desirable seclusion.

The aft lounge, ordinarily used for second-cabin passengers, was converted into a commodious meeting place for medical and popular gatherings. With its stereopticon lantern accommodations, it was available day or night, and furnished a delightful place for discussions of all kinds. The aft smoking-room, too, was an exclusive resort for card games and social confab. The main lounge,

music-room, and smoking-room contained the usual luxurious accommodations for the more conventionally inclined. An out-of-door swimming tank of generous capacity on the aft deck was an everlasting source of refreshment and exercise for young and old. The cabin service and the dining-room service were well organized, and offered the very best that a well regulated ship sailing under the British flag could furnish.

5. OUR MISSION

Among the many objects of our mission, which was abundantly fulfilled in actual accomplishments as we pursued our journey, were recreation in a tropical atmosphere far removed from the winter climate; social intercourse with our Latin American neighbors; an observation of their methods of practicing medicine and surgery; visits to their institutions of learning, especially their medical schools; a study of their hospitals and their method of organization; intimate contact with the members of the surgical profession working in their accustomed environment; and enjoyment of the hospitality of their cities, their governments, their clubs, and their places of amusement.

6. HIGH SPOTS OF OUR EXPERIENCE

The lover of the sea could conceive of no greater degree of pleasure than the ocean voyage from a New York port in February, south to Havana and Panama, east to Colombia, Venezuela, and Trinidad, past the mouth of the Amazon, across the Equator, east around the great bend, diagonally west again to Rio de Janeiro, south to Santos, Montevideo, and Buenos Aires, and then, after much sightseeing and many happy experiences, returning with a few stops to the starting point. It is a succession of balmy seas, undisturbed by storms, and an experience of restfulness that cannot, I am sure, be excelled.

7. HAVANA

At Havana our committee was met by a group from shore, immediately upon lowering our gangplank, consisting of a reception committee from our own Embassy, an official representative of the Government, and the Fellows of the College in Cuba. First was our genial and strenuous Major General Enoch H. Crowder, who within the hour had received almost simultaneously notices from the State Department and the War Department of Washington announcing, first, his appointment as Ambassador to Cuba (a newly created position), and, second, his retirement as Major General of the United States Army. Next our sympathetic Dr. José E. Casuso, and Dr. José A. Presno y Bastiony, both Honorary Fellows of the College, with their confrères, and the representatives of the president of the Republic, Señor Dr. Alfredo Zayas. Following the formal greetings and the necessary photographing by an enterprising group of journalists, our party was informed that the President was to receive us at four o'clock in the afternoon, and the other details of our day's program were arranged.

At the Seville Hotel, where practically all members of our party lunched, Ambassador Crowder and his staff were our personal guests. In the midst of the luncheon I announced the new honors that had come to our great friend, General Crowder, and the enthusiastic applause he received brought him forward to make his first speech as United States Ambassador to Cuba. Following his talk, the luncheon was almost forgotten because of an impromptu reception line that was immediately formed by our people who wished to shake the hand of the man who had so successfully organized the Selective Service Draft for the Great War. It was a great event for us, and obviously pleased the new Ambassador.

At four o'clock Ambassador Crowder appeared and led the procession that proceeded two by two on foot from the hotel to the President's palace, two blocks distant. Our long line of people, headed by the man who has become a great friend to Cuba, attracted the attention of the many pedestrians on the streets. On arrival at the palace, we were received by the President and his Señora, who were assisted by the officials of our party and Ambassador Crowder.

Several interesting drives about Havana were provided for the sightseers, and a number of private luncheons and dinners entertained special friends.

8. PANAMA

It is always an inspiration to any traveler, and much more to a citizen of the United States, to approach Panama and slowly to make the landing at Colon. There is the fascinating beauty of the shore line, with its projections, its islands, and its bays, with its wealth of billowy green foliage, out of which peep red-roofed structures made by man and stalwart palms,—and to all of this is added the romance of history, the early landing of Columbus, the surprise of the enterprising Balboa, the sport of pirates, the early adventures of the Spaniards, the struggle against pestilence and disease, the enterprise of de Lesseps, and the final triumph of sanitation and engineering in overcoming the ruthlessness of the tropics and bringing forth a princely paradise.

Our friends of old were at the dock to meet us, to greet us, and to guide us. Our party proceeded across the Isthmus to Balboa and Panama by relays of railroad and ship to inspect the Canal. At Panama a program had been planned which had for its principal feature the laying of the corner-stone of the Gorgas Memorial Institute of Tropical and Preventive Medicine. As the acting president of the Gorgas Memorial Institute, I had been requested by marconigram the day before to respond to the address to be delivered on this occasion by President Belisario Porras. On the beautiful site presented to the Gorgas Memorial Institute by the Republic of Panama an open pavilion had been erected to accommodate the speakers, the Government officials, and the distinguished guests. An audience of many hundreds had assembled, and on our arrival we proceeded to the pavilion through a narrow lane that was kept open by soldiers. A large band enlivened the scene with its music. An address was made by President Porras, whose delivery was that of a trained, impassionate orator, and he was received with great enthusiasm. He was followed by Dr. Augusto S. Boyd, who delivered an address of welcome to the English-speaking strangers, and a short response by myself. President Porras then, assisted by the other members of his committee and the writer, secured with trowel and mortar an appropriate tablet on the site of the future home of the Gorgas Memorial Institute. It was an inspiring occasion. At our right as we spoke was an heroic plaster bust of General Gorgas, and its life-like features, with the genial smile playing about its face, encouraged us who loved him to believe that he was there in spirit to lend approbation to our action.

The site selected for carrying on the work of Gorgas is located on a point of land which projects into the Bay of Panama, and commands a view of the heights of Balboa, Ancon Hospital, and the far-away hills and mountains bordering the Canal; it lies in close proximity to the new Santo Tomas Hospital which is partially finished, all occupying a generous tract of land on the old exposition grounds.

In the evening President Porras gave a formal reception at the Executive Mansion to which all members of our party were invited, as well as the society of Panama and the Canal Zone. It was a brilliant affair, combining cordiality of the highest type and an oriental display of hospitality that is seldom seen in these days of somber lights, and it warmed the hearts of the most stolid.

During the reception, an Honorary Fellowship in the College was conferred on Dr. Augusto S. Boyd, a distinguished surgeon of Panama, by the officials of the American College of Surgeons.

The President is not only a beloved executive and a man of strong personality and culture, but he has within him the power to impart enthusiasm to his associates and the quality the Spaniards express as "sympatico." It may be said, without danger of refutation, that he succeeded in making a friend of every member of the American College of Surgeons who visited Panama; and as to their wives, they are still inquiring when we shall go back to beautiful Panama and to their friend, President Porras.

9. COLOMBIA

Cartagena, Colombia, was our next stopping place, and that most ancient of all cities of the western hemisphere, with its protecting wall still in good repair, gave us a glimpse of the civilization of this most northwesterly Republic of South America. A drive about the city, a visit to the Governor, Señor Doctor Roman, a survey of their large municipal hospital, luncheon in the out-of-door pavilion of the Club La Popa, and a tea dance at their seashore club, Miramar, created an atmosphere that was enjoyable, interesting, and never to be forgotten. Colombia has four Fellows of the American College of Surgeons, three of whom live in the interior, at the capital, Bogotá. Special envoys from there, and officials of the medical societies of Colombia, called on us and presented the compliments of the medical men of the Republic. Dr. Rafael Calvo, C., of Cartagena, our host of the day, and one of the distinguished surgeons of the country, welcomed us with true hospitality. In the evening we conveyed him to our ship, and in the presence of members of his family, the Governor and other guests, Dr. MacDougall conferred upon him an Honorary Fellowship in the College.

10. VENEZUELA

We called at La Guayra, the port of entry to Caracas, Venezuela, on a beautiful morning, February 23. The snug little hamlet with its small exposed harbor lay before us, and a succession of imposing shore mountains of the Sierra Nevada coast range, covered with green, rose from the beach line and were the foot-hills of a bewildering bulwark of mountain terraces which terminated far above in snow-capped peaks. Laboriously and slowly we made a landing in the ship's boats, aided by a small coast tender loaned to us in our emergency. On two trains we proceeded to Caracas, which is nestled on a plateau twenty miles away by rail, and six miles distant from the coast

as the crow flies. Among the mountains above the sea we rose and meandered around the peaks, on ledges of barren rock, through tunnels, over trestles, and enjoyed a succession of scenes of one of the famous mountain rides of the world.

On arriving at the capital, we were whisked to the official residence of the President of Venezuela, General Juan Vincente Gómez, where our party was received by him and his entire cabinet, including the wives of the President and his officials. The reception room was on one side of a beautiful patio and was an imposing hall of about seventy-five by fifty feet, with a high ceiling. The carved walls were decorated with portraits of ex-presidents and generals of the Republic, nearly all of them in military dress. The President, a strong man with a military bearing, and several of his cabinet officers were in khaki uniforms. Military guards were all about the palace; and with the uniforms, the bright colors of the decorations and the ladies' dresses, the entire scene was of unusual impressiveness. The President is an animated individual, and entered into the spirit of hospitality. He was ever ready to accommodate the ubiquitous photographers and posed for many pictures.

After the reception our party divided and the men and women lunched at separate hotels. Later the surgeons visited the hospitals, inspected the well-equipped laboratory of tropical medicine and other governmental institutions, and in all too short a time we glided down the scenic railroad to our ship in the blue waters of the bay three thousand feet below.

A committee of the Fellows of the College, headed by Dr. Luis Razetti, remained with us during the day and until we waved them adieu at twilight on the little landing in La Guayra.

II. TRINIDAD

We drew a surprise from Captain Byrne on Sunday, February 25, when he gave us a look-in at the beautiful city of Port of Spain on the island of Trinidad. As this was not on our itinerary, we were on our own, and succeeded in spending an interesting day in long country drives into the interior, examining some of the curious places, and enjoying the hospitality of the institutions and hotel. Trinidad, not unlike many of the islands of this archipelago, would make an ideal dwelling place for one who enjoys the charm of the equable climate of the tropics and an old civilization.

III. BRAZIL

Regretfully, because of loss of time, we skirted the great breast of Brazil, by the mouth of the greatest river, and down by its old cities of Bahia and Pernambuco, which we could not visit at that time, and kept our appointment in the most beautiful city of the world. We cast anchor at Rio de Janeiro on the morning of March 7 and were met by representatives of the Government, Ambassador Edwin V. Morgan, members of the medical profession and of the Brazilian exposition. They presented to us a program that they had arranged which included an audience with the President that very afternoon, a reception by the Minister of Justice at the Gloria Hotel that evening, a visit the next morning to the Oswaldo Cruz Institute of Tropical Medicine, and finally a reception at the medical school in the afternoon. In accordance with this program, President Arturo da Silva Bernardes, assisted by his officials and Ambassador Morgan, received all of our people at the Executive Mansion, and made us happy by consenting to photographs and a motion picture scene with us that will enable us to preserve a valuable record of the reception.

That evening a brilliant ball was given at the new Gloria Hotel, where in resplendent informality we were greeted by Senhor Doctor João Luiz Alves, the Minister of Justice, in a formal speech, to which I replied. Both of these talks were interpreted by a representative of the Government, Senhor Felix Pacheco, Chancellor, for those not understanding either Portuguese or English.

We danced away the evening in this beautiful ball-room, from the windows of which we could observe Sugar Loaf and the many undulations of the bay, outlined by beads of electric lights, in the center of which was emblazoned in splendor the Exposition.

Guided by that most splendid of all hosts, Carlos Chagas himself, the distinguished director of the Oswaldo Cruz Institute, a large group of our Fellows wended their way early the next day to the Institute, where we feasted on the scientific display and on the very delightful repast that he had to furnish us.

That afternoon, although a number of our party had been drawn away by the physical attractions of Rio de Janeiro, we visited the medical school. This was one of the most attractive receptions that was accorded to us. The members of the faculty were in academic dress, resplendent in color and dignity, and made us regret that we had not come in our Fellowship gowns. In the great patio of the quadrangle that represents the buildings of the college, was a large military band which regaled us with inspiring music while we visited the marvelous institution that has been so completely planned by Dr. Aloysio de Castro. Then in a brilliant convocation hall, in the pres-

ence of the students, distinguished guests, and our own people, Dr. de Castro greeted us by an address in English, to which our acting president, Dr. MacDougall, responded. Refreshments were served, and after surveying the building and classrooms, we departed, filled with admiration for their most comprehensive place of learning.

That evening the Academy of Medicine of Rio de Janeiro entertained the Fellows of the College and their wives and friends at the Exposition, and in the Palace of Festivals at 9:30 o'clock we held a formal medical meeting, attended by the members of the College in their Fellowship robes. It was a brilliant gathering. Professor Dr. Miguel Couto, president of the Academy of Medicine, presided. Dr. John Osborn Polak and Dr. F. N. G. Starr of our party, and Fellows Dr. José de Mendonça and Dr. Fernando Vaz of Rio de Janeiro, read short scientific papers. President Couto conferred upon Dr. MacDougall, our acting president, and on me as director general, Honorary Fellowships in the Academy of Medicine of Rio de Janeiro, which included the presentation of handsome medals. The American College of Surgeons conferred on Dr. Olympio da Fonseca an Honorary Fellowship.

During these two days of brilliant entertainment, many of our ladies and Fellows stole away and enjoyed the wonderful sights and interesting places of Rio de Janeiro. On Friday and Saturday of the week some of us took occasion to seek out their clinics, their hospitals, and other things of interest to the medical mind. On Friday a number of us visited Petropolis, and enjoyed a survey of this summer capital, a visit to some of our friends of old, and the acquaintance of new friends of value.

This sketch is not a book—the only thing that could even attempt to describe Rio de Janeiro. Therefore, we must remain satisfied to mention that the beauty of Rio de Janeiro was everywhere about us as we pursued our rapid pace. And here, busy showing us the high spots, were our old friends, the Fellows of the College, and always at our side, strenuous as ever, was Dr. Oscar Clark.

13. SANTOS AND SÃO PAULO

On Saturday, March 10, our party divided, about fifty traveling by railroad across country to São Paulo, the great coffee state of Brazil, and the others continuing on our ship to the port of Santos, the coffee outlet for São Paulo and the surrounding country, where we again joined our forces. Sightseeing was our principal object on this part of our trip. At São Paulo, however, our hosts of other years, members of the College and local officials, urged upon those taking the inland trip and those who would make the two-hour railroad ride from Santos in response to a hasty invitation, to partake of an elaborate and beautiful banquet which was given at the famous Automobile Club in São Paulo.

The following morning a number of our Fellows attended clinics at various hospitals, and here they were able to judge of the excellent scientific work of the surgeons of São Paulo. An invitation to attend a reception by the governor, extended through our gracious host, Dr. J. Alves de Lima, had to be regretfully declined because of the inability of all of our people to get together.

14. ARGENTINA

The three days of delightful rest on our comfortable ship, after our interesting entertainment of a week in Brazil, were very welcome, and that brought us on the morning of March 16 to the port of Buenos Aires, where we were to spend five days in sightseeing and entertainment—social and professional enjoyment. Dr. Marcelino Herrera Vegas, Dr. José Arce, Dr. Frank Pasman, Dr. Ricardo Pasman, Dr. Robert Halahan, other Fellows of the College, our Consul, a representative of Mr. John Riddle, our Ambassador, and officials of the Argentine Government were early on board to welcome us. An elaborate schedule of clinics was handed to us, one that filled our surgeons with joy. Sightseeing rides and excursions had been prepared by our official guides, Thos. Cook & Son, and with these had been interspersed official entertainment which did not conflict. The high points were a reception by Ambassador Riddle, a reception by the president of the Republic, Señor Dr. Marcelo T. de Alvear, a reception at the headquarters of the medical society, a visit to the medical school and the Department of Sanitation, and finally our Convocation at the medical school. An Honorary Fellowship was conferred upon Dr. Marcelino Herrera Vegas, and Dr. Arce, rector of the University, Dr. MacDougall, and the writer made addresses, followed by two scientific papers by Dr. James T. Case and Dr. Hugh Young. This function was held in a beautiful academic hall, and was a very brilliant affair. The one hundred odd Fellows of the College from North America wore their Fellowship gowns and occupied the center of the hall surrounding the raised platform on which were gathered the members of the Faculty of Medicine of Buenos Aires; the ladies and members of the local profession occupied places immediately back of the Fellows of the College, and a large number of medical students were massed in the aisles, the window and door spaces, and in a solid group in

the rear of the dais, forming an effective and interesting background.

There were many private entertainments which kept everybody busy, one of the most enjoyable being a luncheon given by Dr. Herrera Vegas to a large group of our ladies at the Plaza Hotel. Following this there was an excursion of Fellows and ladies to Las Hermanas, his large *estancia*.

On Wednesday morning, March 21, fifty of the members of our original excursion departed from us to return by the West Coast. The account of this portion of our cruise will be detailed by Dr. Salisbury, who accompanied the party.

15. URUGUAY

The prow of our ship was now turned homeward, although the next morning, on March 22, we docked at Montevideo for a three days' sojourn. Again we were greeted by the distinguished citizens of the metropolis of a South American Republic. The members of the College, the Dean of the Medical Faculty, representatives of the Government, of our own United States, Minister Philip and our Consul, were there to meet us. After the greeting and the inevitable camera practice that is always conspicuous in the Latin American countries, we drove to the medical school and the university.

For three days we were the recipients of a continuous round of delightful entertainment, and were given an opportunity of visiting all places of interest to members of the profession of medicine. The high points were visits to the innumerable clinics and hospitals and their medical school, a reception by the president of the Republic, Señor Dr. José Serrato, a reception and tea by our Minister, Hoffman Philip, and a formal evening medical meeting, attended by our Fellows in their College gowns and presided over by a Uruguayan Fellow of the College, Dr. Alfredo Navarro, president of the Society of Surgery of Montevideo, at which four of our Fellows—Dr. James F. Barnhill, Dr. A. J. Crowell, Dr. R. D. Kennedy, and Dr. James T. Case—presented formal scientific papers. Besides, small groups of the Fellows and their ladies interested in a variety of subjects were entertained by our hospitable hosts at luncheons and dinners.

Montevideo, since our first presentation of the ideals of the American College of Surgeons three years before, has been keenly interested in the College. In this smaller of the South American countries, affiliated with the College are seventeen of their leading surgeons, and the Committee on Credentials at this time unanimously recommended for Fellowship fourteen additional candidates. Two of the Fellows of the College from Montevideo, Dr. Horacio Garcia Lagos and Dr. Enrique Pouey, were in Europe at the time of our visit; and Dr. Juan Pou Orfila and Dr. Julio Bauzá, accompanied by members of their families, returned on our ship, each to spend eight months making a study tour of our clinics. They are already conversant with our language, and we hope and trust that they will return from this visit with their love for our country enhanced, and that they will come to us again and again.

16. RIO DE JANEIRO AGAIN

Rio de Janeiro, as we crept into her beautiful bay in the early morning of March 28, was again revealed to us in all of her glory. The mists and clouds had disappeared, and the shore line, the mountains, and the terraced city lay invitingly before us. A schedule of clinics greeted the insatiable surgeons, and the shops and places of beauty beckoned to the shoppers and sightseers. All of our friends were there to welcome us, and before us were two days for thorough enjoyment of this beautiful city of the world. On the second day, with the hosts impressing upon us their genuineness of friendship, our ship once more sailed forth, and we were truly on our way to our own homes in North America.

17. BARBADOS

Five days out we received a marconigram from our American Consul, Mr. John J. C. Wilson, and the medical profession of Barbados, inviting our cruise party to a reception at the Savannah Club on the afternoon of Saturday, April 7. On arriving at this interesting little British possession we were greeted on all sides by a pleasing hospitality, and the formal reception that was planned for us in advance was heartily enjoyed by us all. The shopping and sightseeing vied with our social activities, and we said good-bye with a genuine regret that we were on the last leg of a wonderful voyage. We had before us one more week of our ocean home that we had learned to love, with its congenial family, and then we began to think of home as on the evening of Friday, the thirteenth, we espied the lights from the "great white way" and we were anchored at quarantine within the "three mile limit."

18. HOME AGAIN

For the third time we had made the voyage. For the third time we had been fascinated by a wonderful people of Latin America. As on previous visits we vowed that we had become neighbors, and that we would repeat our visit again and again.

II. Supplementary Foreword

By EDWARD L. SALISBURY, M.D., Denver, Colorado

1. DEPARTURE OF WEST-COASTERS

At eight-thirty o'clock on the morning of March 21 the shrill whistle of the "Internacional" echoed through Retiro Station of the Buenos Aires and Pacific Railroad. It shrieked a warning that fifty West-Coasters were leaving the cruise party of the *S. S. Vandyck* to enjoy thrills not to be had by the remaining cruisers who enviously followed the little group that morning to the station. There was a near panic among the West-Coasters as we scrambled for our cars lest we be left behind to retrace our steps on the *S. S. Vandyck* and miss a trans-continental tour and a cruise upon the South Seas.

The trip to Buenos Aires had been a glorious one—replete with joys and pleasures, filled with every luxury, and with pleasant associations of old friends and new. We were reluctant to say good-bye and have only memories for our tomorrows; but yet the call of the unexplored beckoned to us, and as we ran for the moving train we carried with us in our hearts a sorrow for those who were to be left behind and to be deprived of a most wonderful trip.

For some time I stood upon the platform as the "Internacional" rolled out of the train-shed, waving adieu to friends of the *Vandyck*. They stood there watching us depart, looking wistfully, longingly, wishing they had joined our party. And being a sympathetic creature I was moved and cast my eyes elsewhere that I might not view their dejection.

2. THE PAMPAS

Having recovered from the ordeal aforementioned, I took stock of the train, which was of the continental type. Our party was allotted two compartment cars and one diner.

Dr. Walter S. Stewart shared "*Camara* No. 4" with me, and after arranging our baggage and lighting our cigars, we settled comfortably into the cushions to take note of the terrain en route. We were now hurrying through the environs of Buenos Aires, with healthy signs of business and industry in the factories. The little houses or *casitas* of the outlying districts flew by;—we caught a glimpse of the Rio de la Plata in the distance, and soon were out upon the broad expanse of the Argentine pampas. As far as eye could see, like a restless ocean, stretched the waving green of the pampas grass, with here and there the hoary whiteness of its bloom appearing as white-caps in the surf. The far-scattered ranch-houses, with their ever-present windmills, dotted the horizon, and loomed like ships upon the deep. The illusion was constant, and one continually felt that he was riding along some coast-line, gazing seaward.

We came upon the great cattle-raising section and saw immense herds of fine cattle that were destined for the great markets of Buenos Aires, of Europe, and often the United States. Frequently we saw flocks of ostriches feeding in their awkward fashion in these great pastures. It was all so interesting, and as we drank in the unaccustomed view the porter informed us individually that *almuerzo* or luncheon was being served in the diner ahead. We entered and received a service of numerous courses, typical of the great hotels of South America. Leisurely we ate and viewed the passing scenes, the monotony of the pampas broken by lagoons and ponds alive with wild duck and geese; and occasionally large flocks of flamingos were seen standing knee-deep in the morass, like flaming sentries.

After a hearty luncheon, slowly consumed, came a welcome *siesta*, from which we were summoned to tea and cakes, or *Quilmes Crystal* and biscuits. A surprise awaited us without, for we were now entering the great agricultural belt. It was autumn, and a series of gasoline tractors were pulling great gang-plows, preparing for the sowing of the winter wheat. A few months earlier golden grain would have greeted us, and we might venture to suggest that oxen were used for plowing.

With like scenes, interspersed with pastures and grazing cattle, and now and then a *gaucho* or cowboy in full regalia riding out to his herds, we passed the hours until sunset and darkness came. Another meal was served, and afterward the diner became a social hall while the berths were being made up, in which we soon sought refuge as we were to arrive in Mendoza early the next morning to change to the Trans-Andean train.

3. THE ANDES

At six o'clock we were aroused and had just time enough to shave and have a cup of coffee before we arrived in Mendoza. In the early dawn, far to the westward, we could see the brown foothills of the Andes, and as the sun cleared the air,

the distant snow-caps became visible, with the volcanoes Tupungato and Aconcagua towering majestically over all. Spread out around us were the vast vineyards of Mendoza, the great wine-producing section of the Argentine.

At Mendoza we changed to our special narrow-gauge train for the trip across the Andes to Chile. Up to this time we had traveled six hundred miles as straight as the crow flies, and had reached an altitude of nearly 2,500 feet. Breakfast was served aboard immediately, and we began our climb to the foot-hills. The track follows the course of the Mendoza River, whose waters supply the great irrigation system used in the vineyards.

We soon found ourselves traveling over a great moraine, the remnant of glaciers of ages past. All vegetation, except a few scrub bushes and cacti, disappeared, and our laboring engine told us that our climb of the Andes had begun. In a few hours we were conquering the bleak mountain barriers, and we lunched while our train struggled up a rack (cog) road at an elevation of seven thousand feet. On every side giant mountains rose to stupendous heights—desolate but majestic, eager in their solitude to echo the noise of the engine that alone disturbs the quiet. For centuries only the halloo of the muleteer, wending his way over Cumbre Pass, broke the stillness that reigned supreme; but a decade or two ago the ring of iron and steel, and the hissing of steam resounded through mountain and vale, proclaiming man's triumph over a wilderness.

Occasionally we caught glimpses of snowcapped peaks, and fifty miles up the Tupungato Valley we saw the extinct volcano of the same name with its majestic peak raised some 22,000 feet heavenward. We passed *Los Penitentes* (The Penitents), a mass of volcanic pinnacled rock carved by nature and time to resemble a procession of cowled monks marching toward cathedral-like spires.

The air was chill as we left the train at Puente del Inca to view the great natural bridge of the Andes which spans the Cuevas River. The hotel near the sulphur springs is the starting point for excursionists to the monument of Chilean-Argentinian peace, "Christ of the Andes." The statue is not visible from the railroad which passes at a level of some 2,500 feet below.

Toward evening we entered the two-mile tunnel through the International and Continental Divide two miles above sea level, or, to be exact, 10,400 feet, and emerged on the Chilean side. Here we met the headwaters of the Aconcagua and Juncal rivers that flow Pacificward to irrigate the vineyards of Chile. The route is now through the Chilean Andes, but darkness overtook us and we had to forego the pleasure of seeing the *Salto* (Soldier's Leap). As our train was late, we dined aboard instead of in Los Andes. At this stop we changed to the broad-gauge Chilean State Railway, and were whisked off to the capital, Santiago. We reached our hotel and deserved rest at 2:00 A.M., after forty hours of travel.

4. SANTIAGO, CHILE

At Los Andes we were met by Dr. Edwyn P. Reed of Valparaiso, the Secretary of our Committee on Credentials. He accompanied us to Santiago and informed us of the program they had prepared for us. The following morning we were received in Del Salvador Hospital by the Fellows of the College in Santiago, including Dr. Reed and Dr. Muennich of Valparaiso, members of the Faculty of Medicine, and students. At a meeting in the amphitheater of the hospital, Dr. Hugh H. Young presented Dr. Gregorio Amunátegui, surgeon, dean of the Medical Faculty of the University, and recently elected president of the University, for Honorary Fellowship in the American College of Surgeons. This honor of the College was conferred by Dr. Truman W. Brophy, our acting president for the West Coast meetings.

Dr. Amunátegui was greatly moved by the honor, and accepted enthusiastically the *Toga Collegii*, expressing his gratitude and declaring himself an humble disciple among the ranks to hold sacred the ideals of the American College of Surgeons.

The remainder of the morning was consumed by sightseeing and visits to the institutions and hospitals in company with the Chilean Fellows and members of the profession, prominent among them Dr. Lucas Sierra, Dr. Luis Vargas, Dr. Caupolican Pardo Correa, Dr. Francisco Navarro Valenzuela, and others. At noon we enjoyed their hospitality at the Union Club, and in the afternoon we were received by the United States Ambassador, Honorable William Miller Collier, at the Embassy, a beautiful edifice and one of the few owned by the United States, of which we should be justly proud.

At four o'clock we were received in the Government Palace by the president of the Republic, Dr. Arturo Alessandri, who has just written the new health code for the country.

Santiago was in gala attire for the opening of the Fifth Pan-American Congress, recently in session. It is a city beautifully located upon many hills, and in little vales with attractive buildings and wonderful parks. I regret that our

time in this city was so short and that we could not remain longer in the company of its surgeons.

5. VALPARAISO, CHILE

On the morrow we entrained for Valparaiso, the great port of Chile, where we arrived at noon. The city is so named from the Valley of the Paradise, the fertile vale through which we passed en route from Santiago. Valparaiso is builded in the form of an amphitheater with the busy harbor as the stage. Three streets parallel to the shore line form the main business section of the city, while the residential section extends up the hillsides and out along the beach to Miramar and Viña del Mar.

Dr. and Señora Guillermo E. Muennich gave a beautiful garden party and tea for us at their home on Cerro Alegre (Happy Hill). They have a wonderful home and gardens overlooking the city and sea, and here we met many of our Fellows and their families, including Dr. Edwyn P. Reed, Dr. Alberto Adriasola, Dr. Rudecindo de la Fuente, Dr. Gaston Lachaise, Dr. Jean H. Thierry, Dr. Miguel Manriquez, and others. A visit to the hospitals of Valparaiso impressed us with their complete conception of a modern hospital. The Committee on Credentials for Chile presented the names of fourteen surgeons as candidates for Fellowship, and expressed themselves as determined to work for higher standards in their hospitals.

Dr. Reed, with four of his fine family of eight sons, accompanied us aboard our ship, the *S. S. Essequibo*, which sailed at noon on Sunday, March 25, northbound for the equatorial waters of the Pacific.

6. THE WEST COAST

We made several interesting stops along the barren coast of Chile—Antofogasta, Mejillones, and Arica, where we inspected the hospitals. At Arica we took a train across the desert to the city of Tacna, a small oasis. Here in the heart of the desert is a garden spot that is being extended by an irrigation system that will some day make it a great farming center. It was a memorable day. After a long trip across the hot sands, to find oneself in a beautiful vineyard and orchard, feasting upon delicious white, blue, and red grapes, peaches and figs from vine and tree, direct from producer to consumer, seemed a marvel indeed; and all this through the courtesy of Mr. Clarence Elliot, the British Consul and manager of the railroad.

After luncheon at the Raiteri Hotel and a visit about the city, we returned to Arica and our ship. The next day was spent at Mollendo, Peru, where cargo was taken aboard. The most striking thing of the ports are the myriads of guano birds that circle about in flight, almost in dense cloud formation.

7. LIMA, PERU

On Monday, April 2, we arrived in Callao, Peru, the port for the capital, Lima. Dr. Juvenal Denegri, Dr. Miguel Aljovin, Dr. Ricardo Palma, and Dr. Alejandro Bussalleu welcomed us at the port and accompanied us to Lima. We had but a few short hours to stay in that wonderful city; but we were able to see most of the interesting sights and visit the hospitals, University, and Medical School.

The Surgical Society of Peru, Dr. Miguel Aljovin, the president, presiding, entertained us at luncheon in the National Club, at which the wives of a number of local surgeons were present. Dr. Aljovin welcomed us in the name of the Surgical Society, eulogizing the surgeons of North America, their contributions to science, and the admirable organization of northern universities. Dr. Francisco Graña translated the address, and Dr. Truman W. Brophy responded, following which Dr. William F. Grinstead toasted the surgeons of Peru as representing the culture of the South. At a meeting of the Credentials Committee, four new candidates were presented, and Dr. Guillermo Gastañeta asked us to carry back the message that the Fellows of Lima were working to bring their hospitals up to the Minimum Standard.

One could spend several weeks in Lima, the City of Kings, visiting the Spanish-Colonial buildings and viewing their carved interiors. They are examples of the fine work of the artisans of those times, as are the paintings and tilings. The tiles were creations of both the old world and the new, but today the art is lost and cannot be duplicated even in Spain.

The new museum of San Marcos University, named for its founder, Señor Javier Prado, is carrying on studies and investigations destined to enlighten us on the history of the Incas and Tiahuanacos, and the aborigine tribes, the Chimus and Nascas, of which many monoliths remain.

We bade a hasty farewell to our friends of Lima and departed from their shores at sunset.

8. HOMEWARD BOUND

Our course was now set for the Panama Canal, and we arrived at the Balboa docks on the morning of April seventh. The party was divided, one group passing through the Great Gateway on the

steamer, and the other spending a few hours in Panama and going to Colon by rail.

Since our visit in February much interest has been aroused locally in the Gorgas Memorial Institute of Tropical and Preventive Medicine. The Chamber of Commerce and Rotary Club have nominated a committee to represent Panama in raising an endowment for this institution. A similar plan is to be carried out in every country, state and province where the name of William Crawford Gorgas, soldier and sanitarian, is revered.

We left Colon on the night of April 7, New York-bound via Havana. The time aboard ship was profitably spent in interesting medical meetings, reviews of the cruise, and exchange of impressions of the countries visited. Deck golf was the most popular sport. The "races" and a "bull fight" afforded great amusement.

A birthday dinner was tendered to Dr. Truman W. Brophy, the admirable chieftain of the West Coast party, whom we had learned to revere and love during our happy days of association.

9. DISEMBARKATION

The good ship *Essequibo* reached New York on Sunday afternoon, April 15, its mettle having been tested by thirty hours of severe storm just at the end of our voyage. We were still feeling sorry for our friends who had returned on the *S. S. Vandyck;* but we found that our sympathies were wasted, for those who met us on the dock reported a glorious return voyage, and they had been losing sleep fearing that we were unhappy on a strange ship!

The memory of the friends we made, their kindnesses, the associations, and the good fellowship will outlast time.

There is in each life some time or spot,
Some hour or moment of night or day,
That never grows dim and is never forgot,
Like an unfaded leaf in a dead bouquet;
Some rare season, however brief,
That stands forever and aye the same;
A sweet, bright picture in bas-relief,
Hanging before us in Memory's frame.

MINNESOTA, KENTUCKY AND TENNESSEE, AND VIRGINIA AND WEST VIRGINIA SECTIONAL MEETINGS OF THE CLINICAL CONGRESS

MINNESOTA

THE Minnesota sectional meeting of the Clinical Congress of American College of Surgeons for 1923 was held in Minneapolis on April 16 and 17 in conjunction with the clinic week of the Hennepin County Medical Society. The local arrangements were in the hands of a committee of Fellows of the College composed of Dr. Arthur T. Mann, chairman, Dr. R. E. Farr, and Dr. J. M. Hayes, and assisted by Mr. Roy Nelson. Good advance publicity was given both hospital and public meetings. Headquarters was at the Radisson Hotel where the hospital meeting was held in the Gold Room. This meeting drew a large attendance and the program brought out for discussion many interesting points relative to hospital work. At the meeting of the Fellows following the round table conference, the work of the College was reviewed and the State Committee for the ensuing year elected. The public meeting was held in the Methodist Church and was well attended. The Lieutenant Governor of the State, in a short and interesting address, welcomed the Fellows of the American College of Surgeons to Minneapolis. Besides the College officials, Drs. William Cubbins and Harry Richter of Chicago, Dr. J. E. Rush of the American Society for the Control of Cancer, New York, and the Rev. C. B. Moulinier of Milwaukee, president of the Catholic Hospital Association, took part in this program. The scientific section was in charge of the Hennepin County Medical Society. The state chairman, Dr. Thomas McDavitt of St. Paul, presided at the meetings.

KENTUCKY AND TENNESSEE

ON April 19 and 20, the Kentucky and Tennessee sectional meeting of the Clinical Congress of the American College of Surgeons was held at Lexington with headquarters and registration rooms at the Lafayette Hotel where both the hospital and scientific meetings were conducted. The public meeting was held in the Christian Church and drew a large and interested audience. The local Fellows of the College, headed by Dr. Charles Vance as chairman, composed the committee on arrangements. They were efficiently assisted by Mr. J. Dunn as publicity manager. To the energetic efforts of Dr. Vance and the local Fellows the success of these meetings is due. Clinics were held at the local hospital and were well arranged and carried out. Dr. David Barrow, state chairman for Kentucky, presided at the hospital and scientific meetings. Dr. J. A. Stucky, of Lexington, presided at the public session. There was a good representation of Fellows present from both states. Besides College representatives and Fellows of the College from both states, the hospital and public programs were presented by Dr. George Crile of Cleveland, Dr. Harry Mock of Chicago, Dr. Thomas L. Gilmer of Chicago, Rev. C. B. Moulinier, president of the Catholic Hospital Association, Milwaukee, Dr. J. A. Dieckman of Cincinnati, representing the Protestant Hospital Association, Mr. Robert Jolly of Houston, Texas, Dr. J. Garland Sherrill, University of Louisville, Dr. E. Dunbar Newell of Chattanooga, and Dr. Richard A. Barr. The College was represented by Dr. Malcolm T. MacEachern, associate director for Canada and president-elect of the American Hospital Association, and Dr. Allan Craig of Chicago, associate director of the College. Every one pronounced the Lexington meetings a splendid success.

VIRGINIA AND WEST VIRGINIA

THE city of Norfolk, Virginia, was the location for the Virginia and West Virginia, 1923, sectional meeting of the Clinical Congress of the American College of Surgeons. The meetings and clinics were held on April 23 and 24. Local arrangements for these meetings were in the hands of a committee of Fellows of the College headed by Dr. J. L. Rawls, and Dr. Lomax Gwathmey, chairman of the Virginia state committee. Headquarters and registration were at the Monticello Hotel; here also the scientific and hospital sessions were held. The publicity work for these meetings was in the hands of Mr. Jenkins, of Norfolk, and was very efficiently carried out. The public meeting was one of the largest which the College has had; the Epworth Church was crowded to the doors with a very attentive audience. Besides the usual public program, Dr. Louis Mendoza, of Norfolk, delivered a most inspiring address on the relationship of surgery to the public. Drs. Crile, Mock, MacEachern, Dieckman, and Craig also took part in this program. Dr. Lomax Gwathmey, state chairman, presided at all meet-

ings. The clinics conducted at the local hospitals showed evidence of careful preparation and organization. Dr. Stuart McGuire and Dr. J. S. Horsley, of Richmond, took part in the hospital program. At the meeting of the Fellows of the College, the state committees for the ensuing year were elected and following a review of the work of the College, Dr. George Crile, of Cleveland, gave a brief but interesting résumé of the work of the various research committees. The scientific meeting held on the afternoon of the second day was full of interest for every one as the addresses and papers were short and to the point, permitting opportunity for free discussion.

REPORT OF THE DEPARTMENT OF LITERARY RESEARCH

THE Library and Department of Literary Research of the American College of Surgeons has met a steadily increasing demand for the preparation of bibliographies and abstracts of medical and surgical literature. Over one hundred requests have been received by the Department during the first four months of the year. The service has been quite evenly distributed over the country: twenty-one requests came from New York, Massachusetts, Pennsylvania, and other eastern states; twenty from the southern states; eighteen from the middle west; and twenty-nine from the western states. Eight requests came from Canada and one from Korea to add to the list of inquiries from more distant Fellows of the College.

The requests differ greatly in the type of work desired. In some instances a particular article or abstract of an article is wanted. In other cases a list of references is sent in by the surgeon with a request for abstracts of the articles. Sometimes an interesting case report is supplied, with the request for a review of the literature to obtain reports of similar cases. In still other instances the working up of a bibliography with abstracts and translations is desired to make as complete a report as possible on a subject worthy of comprehensive research.

With the increase in the number of requests for the service it becomes more than ever important that the inquiries be received far in advance of the need for the completed data. Emergency requests are frequently taken care of, but much more complete and better organized data can be furnished at a like cost where more time is allowed.

The package library of material already classified and ready to be mailed out on loan is also of increasing importance. By this means the time spent on any one request is materially shortened so that it has been possible to care for the increase in demand without increasing the staff of research workers.

In this connection the importance is again emphasized of continually adding to this loan material. If every Fellow of the College would supply the Department regularly with articles as soon as they are published as well as previously written articles not already on file, the value of the material classified under the various specialties would be greatly enhanced. The space for this collection in the College Library is being extended to take care of all such contributions. Two copies of all reprints are desired, one for the College file as a permanent record of the works of the Fellows, the other for the classified loan material.

In sending in requests for this service it is always of prime importance to limit the scope of the research work to your specific interest in the subject. The abstracts prepared by the Department are then far more useful and to the point than abstracts prepared for general publication. The Department is occasionally asked for *all* the literature on a subject upon which volumes have been written, when as a matter of fact a few of the important recent articles are all that would be read by the surgeon sending in the inquiry. Such an inquiry coupled with a request to have the material completed in one or two weeks does not contribute to a satisfactory result. You cannot give the Department too much information in your letter of inquiry. In what phases of the subject are you interested? For example, *etiology* of the fused kidney, *anatomy* and *pathology* of the cervix of the uterus, *end-results* of operations for chronic appendicitis, *diagnosis* of renal tuberculosis, *treatment* of cancer of the tongue (surgical treatment as compared with radium and roentgenray) or *all phases* of pancreatic calculi, including *history*, *etiology*, *pathology*, *symptomatology*, *diagnosis*, *differential diagnosis*, *treatment*, and *prognosis*. How many years are to be covered? Recent literature? Past five or ten years? Everything since the review of the literature made by "Jones in 1909"? (Include complete citations when at hand.) When complete information regarding the nature of the work desired is given, no time is lost in getting the research under way, and a satisfactory result is made possible.

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